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Leandro Prados de la Escosura

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This essay offers a new set of historical GDP estimates from the demand and supply sides that revises and expands those in Prados de la Escosura (2003) and provides the basis to investigate Spain's long run economic growth. It presents a reconstruction of production and expenditure series for the century prior to the introduction of modern national accounts. Then, it splices available national accounts sets over the period 1958-2015 through interpolation, as an alternative to conventional retropolation. The resulting national accounts series are linked to the 'pre-statistical era' estimates providing yearly series for GDP and its components since 1850. On the basis of new population estimates, GDP per head is derived. Trends in GDP per head are, then, drawn and, using new employment estimates, decomposed into labour productivity and the amount of work per person, and placed into international perspective.

Keywords: historical national accounts, GDP, output, expenditure, splicing GDP, Spain

JEL Classification: C82, E01, N13, N14

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Leandro Prados de la Escosura
(Universidad Carlos III, CEPR, and Groningen)

Abstract

This essay offers a new set of historical GDP estimates from the demand and supply sides that revises and expands those in Prados de la Escosura (2003) and provides the basis to investigate Spain's long run economic growth. It presents a reconstruction of production and expenditure series for the century prior to the introduction of modern national accounts. Then, it splices available national accounts sets over the period 1958-2015 through interpolation, as an alternative to conventional retropolation. The resulting national accounts series are linked to the 'pre-statistical era' estimates providing yearly series for GDP and its components since 1850. On the basis of new population estimates, GDP per head is derived. Trends in GDP per head are, then, drawn and, using new employment estimates, decomposed into labour productivity and the amount of work per person, and placed into international perspective.

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The dataset can be accessed at http://espacioinvestiga.org/bbdd-chne/?lang=en

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I. INTRODUCTION

The goal of this essay is to present a new set of historical national accounts with GDP estimates from the demand and supply sides, which revises and expands those in Prados de la Escosura (2003) and provides the basis to investigate Spain's economic progress during the last 166 years. Firstly, historical output and expenditure series are reconstructed for the century prior to the introduction of modern national accounts.
Then, available national accounts are spliced through *interpolation*, as an alternative to conventional *retropolation*, to derive new continuous series for 1958-2015. Later, the series for the 'pre-statistical era' are linked to the spliced national accounts providing yearly series for GDP and its components over 1850-2015. Finally, on the basis of new population estimates, GDP per head is derived, decomposed into labour productivity and the amount of work per person, and placed into international perspective.

All reservations about national accounts in currently developing countries do apply to pre-1958 Spain.[1] In fact, Simon Kuznets' (1952: 9) sceptical words are most relevant, "Consistent and fully articulated sets of estimates of income, … and its components, for periods long enough to reveal the level and structure of the nation's economic growth, are not available ... The estimates … are an amalgam of basic data, plausible inferences, and fortified guesses". Thus, despite the collective efforts underlying the historical output and expenditure series offered here, the numbers for the 'pre-statistical era' have inevitably large margins of error.[2] This warning to the user is worth because as Charles Feinstein (1988: 264) wrote, "once long runs of estimates are systematically arrayed in neat tables they convey a wholly spurious air of precision".

Nonetheless, the new series represent an improvement upon previous historical estimates, as they are constructed from highly disaggregated data grounded on the detailed, painstaking research on Spain carried out by economic historians. A systematic attempt has been made to reconcile the existing knowledge on the performance of

[1] Cf. Srinivasan (1994), Heston (1994), and Jerven (2013) on national accounts in developing countries.
[2] Spanish historical statistics edited by Carreras and Tafunell (2005) provide a comprehensive survey of the achievements in quantitative research during the last four decades.

individual industries, including services (largely neglected in earlier estimates), with an aggregate view of the economy.

The paper is organized in five sections. Section II summarises, on the basis of the new GDP series, the main findings about long run aggregate performance and places Spain's experience in comparative perspective. The next two sections address the 'pre-statistical era' (1850-1958) describing the procedures and sources used to derive annual series of nominal and real GDP for both the supply (section III) and the demand (section IV). Then, in section V, the new results are compared to earlier estimates for pre-national accounts years. Lastly, in section VI, the different sets of national accounts available for 1958-2015 are spliced through interpolation, and the resulting series compared to those obtained through alternative splicing procedures and, then, linked to the pre-1958 historical estimates in order to obtain yearly GDP series for 1850-2015.

II. MAIN FINDINGS

II.1 GDP

Aggregate economic activity multiplied fifty times between 1850 and 2015, at an average cumulative growth rate of 2.4 per cent per year (Figure 1). Four main phases may be established: 1850-1950 (with a shift to a lower level during the Civil War, 1936-1939), 1950-1974, 1974-2007, and 2007-2015, in which the growth trend varied significantly (Table 1).[3] Thus, in the phase of fastest growth, the *Golden Age* (1950-1974), GDP grew at 6.3 per cent annually, four and a half times faster than during the previous hundred years and twice faster than over 1974-2007, while the Great Recession represented a fall in real GDP between 2007 and 2013 (8 per cent), and the 2007 level had not been recovered by 2015. Gross Domestic Income (GDI), that is, income accruing to those living in Spain, as opposed to output produced in Spain, shadows closely GDP evolution.

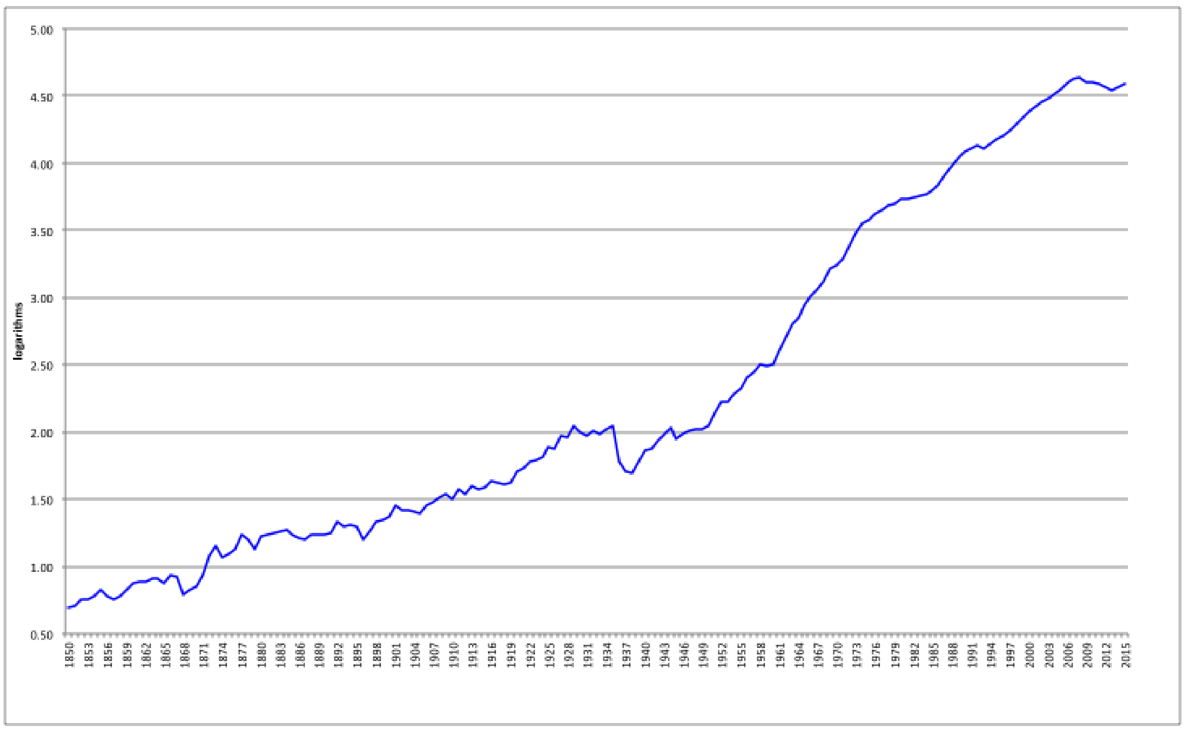

Figure 1. Real GDP at market prices, 1850-2015 (2010=100) (logs)

[3] Main phases defined as deviations from segmented trend estimates with exogenous structural breaks in Prados de la Escosura (2003, 2007b) have been kept here. A change of trend indicates a break in the long-term rate of growth. A change in level, as the drop in economic activity during the Civil War, does not alter the established growth rate.

A look at the evolution of output and expenditure components of GDP provides valuable information about its determinants. Changes in the composition of demand are highly revealing of the deep transformation experienced by Spain's economy over the last two centuries.

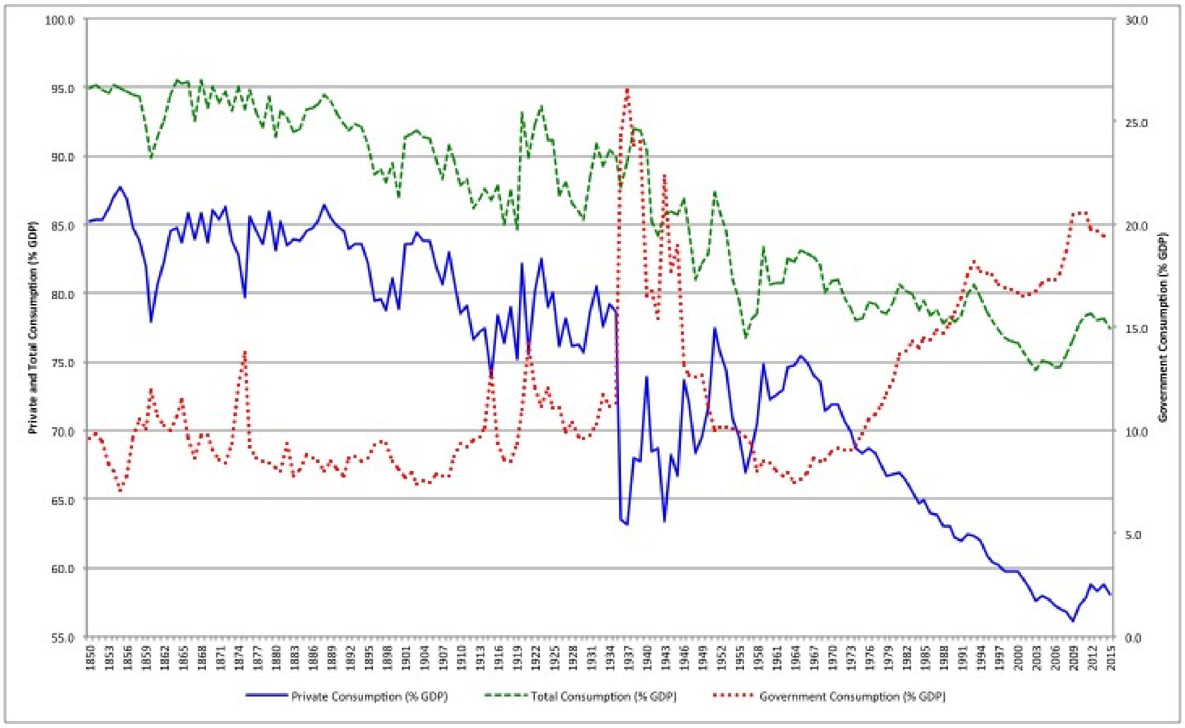

Figure 2. Private, Government, and Total Consumption as Shares of GDP, 1850-2015 (% GDP) (current prices)

The share of total consumption in GDP remained stable at a high level up to the late 1880s, followed by a decline that reached beyond World War I (Figure 2). Then, it recovered in the early 1920s, helped by the rise in government consumption (Figure 2, right scale), stabilising up to mid-1930s. The Civil War (1936-39) and World War II (even if Spain was a non-belligerant country) account for the contraction in private consumption and the sudden and dramatic increase in government consumption shares in GDP. The share of total consumption only fell below 85 per cent of GDP after 1953, when a long run decline was initiated reaching a trough (at three-fourths of GDP) by the mid-2000s. Such a decline in the GDP share of total consumption conceals an intense decline in private consumption (that contracted from 75 per cent of GDP in 1965 to a historical trough, 56 per cent, in 2009) paralleled by a sustained rise in government consumption (that jumped from a 7.5 per cent trough in the mid-1960s to a 20 per cent peak in 2009-2010) that resulted from the expansion of the welfare state and the transformation of a highly centralized state into a *de facto* federal state (Comín, 1992, 1994).

Investment oscillated around 5 per cent of GDP in the second half of the nineteenth century but for the late 1850s and early 1860s when it doubled during the railways construction boom (Figure 3). From the turn of the century a long-term increase took place with the relative level of capital formation increasing from around 5 to above 30 per cent of GDP in 2006. Phases of investment acceleration appear to be associated with those of faster growth in aggregate economic activity, namely, the late-1850s-mid-1860s, the 1920s, mid-1950s-early 1970s, and between Spain's accession to the European Union (EU) (1985) and 2007. Nonetheless, the long-run increase was punctuated by reversals during the World Wars and the Spanish Civil War, the transition to democracy (1975-85), which coincided with the oil shocks, and the Great Recession (2008-13).

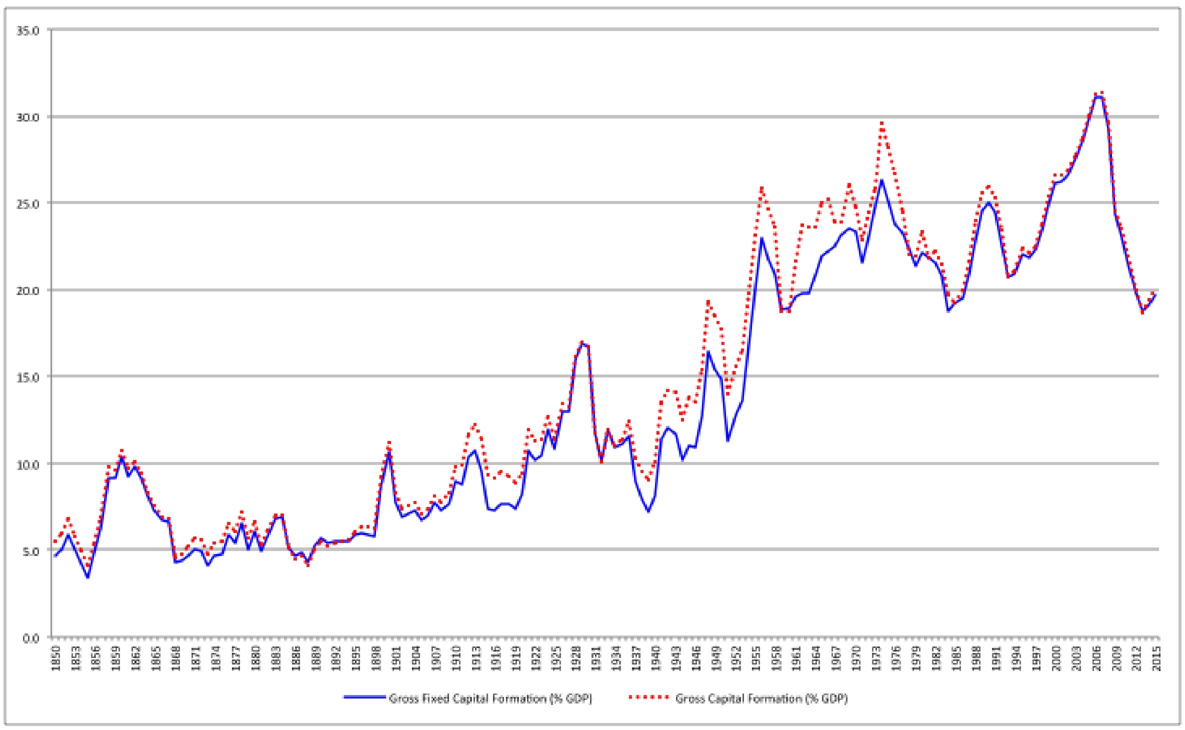

Figure 3. Capital Formation as a Share of GDP, 1850-2015 (%) (current prices)

The breakdown of gross domestic fixed capital formation shows the prevalence of residential and non-residential construction as its main components over time, with a gradual rise of the share of more productive assets (machinery and transport equipment) during the twentieth century up to 1974 that stabilised therafter (Figure 4). The urbanization and industrialization push in the 1920s and 1950s-early 1970s reflects clearly across different types of assets. It is worth noting the increase in the share of infrastructure after Spain's accession to the EU and the residential construction bubble between the late 1990s and 2007.

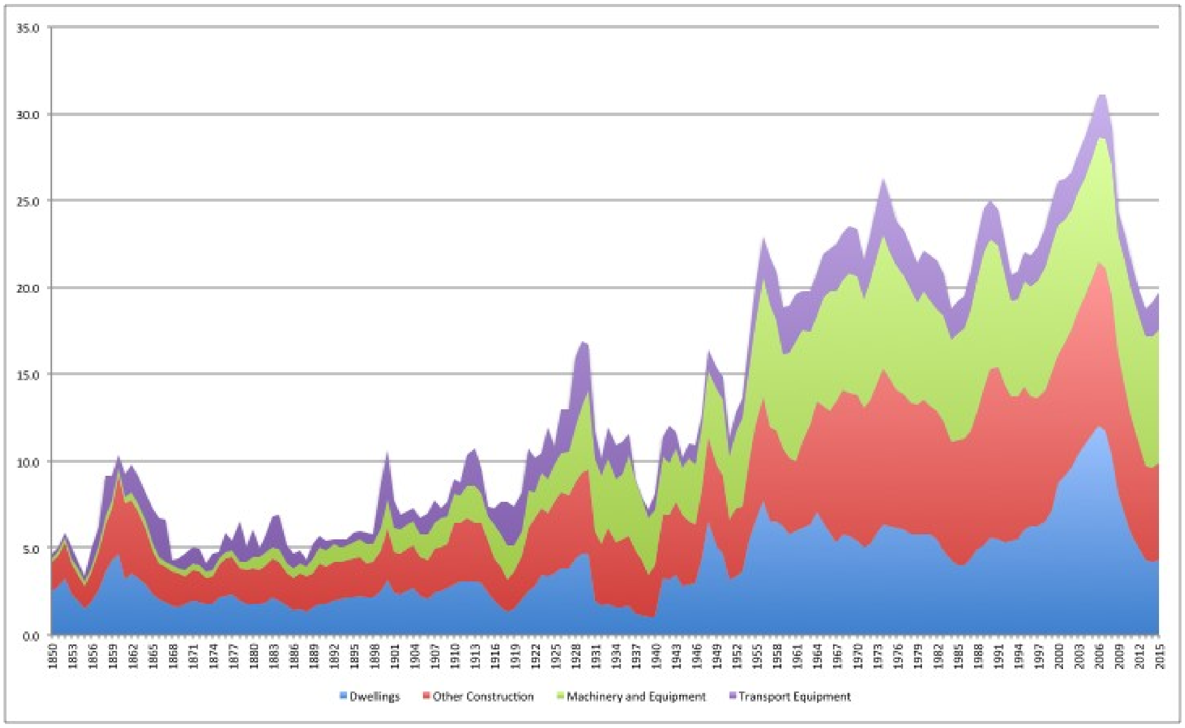

Figure 4. Fixed Capital Formation and its Composition, 1850-2015 (% GDP) (current prices)

The exposition of Spain to the international economy also increased but following a non-monotonic pattern, with three main phases: a gradual rise in openness (that is, exports plus imports as a share of GDP) during the second half of the nineteenth century that at the beginning of the twentieth century stabilised at a high plateau up to 1914; this was followed by a sharp decline from the early 1920s to mid-century that reach a trough during World War II (Figure 5). A cautious but steady process of integration in the international economy took place since the 1950s, was facilitated by the reforms associated to the 1959 Stabilization and Liberalization Plan.

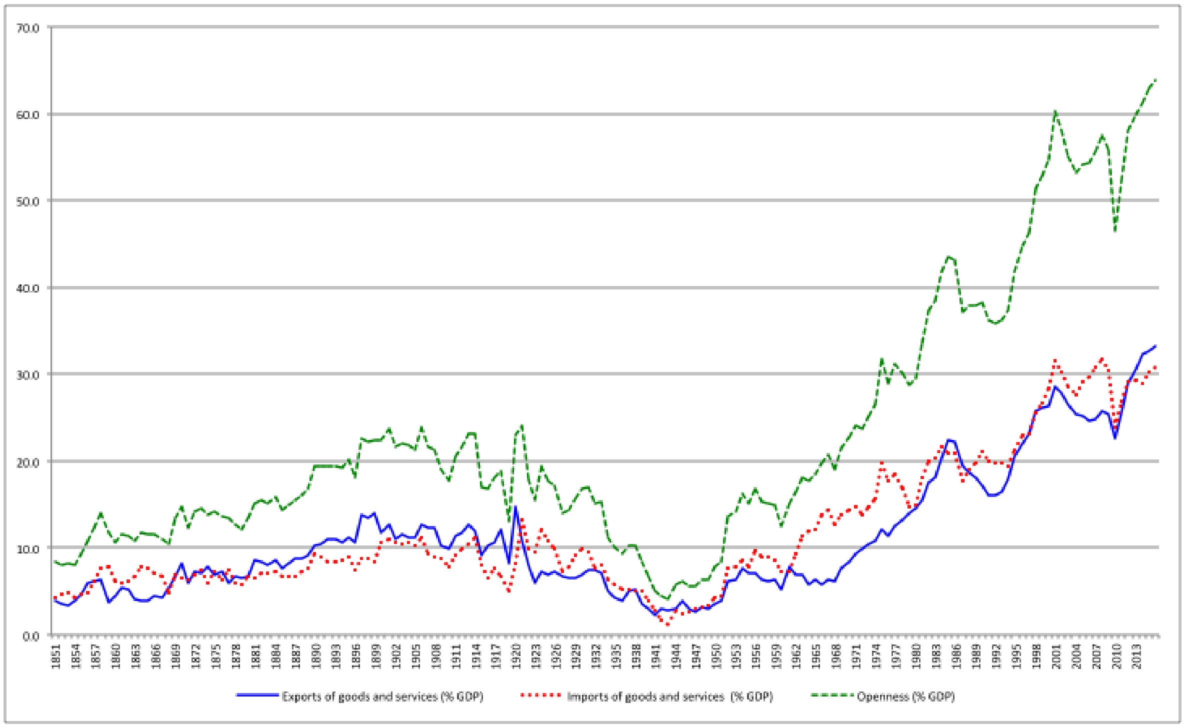

Figure 5. Openness: Exports and imports Shares in GDP (%) (current prices).

How gradual was the post-1950 recovery is shown by the fact that only in 1955 the level of openness of 1929 was reached and that the historical maximum of the pre-World War I years was overcome in 1970. It took longer for exports than for imports to recover pre-World War I relative size (only in 1980 that of the 1910s was overcome). Spain's increasing openness during the last four decades suffered, nonetheless, reversals in the second half of the 1980s and, again, in the 2000s as a result of a contraction in exports.

It is worth mentioning the concordance observed between investment and imports, which suggests a connection between economic growth and exposure to international competition (Figure 6). Furthermore, phases of more intense imports and investment are also those of deficit in the balance of goods and services, which suggests an inflow of capital and a link between the external sector and capital formation.

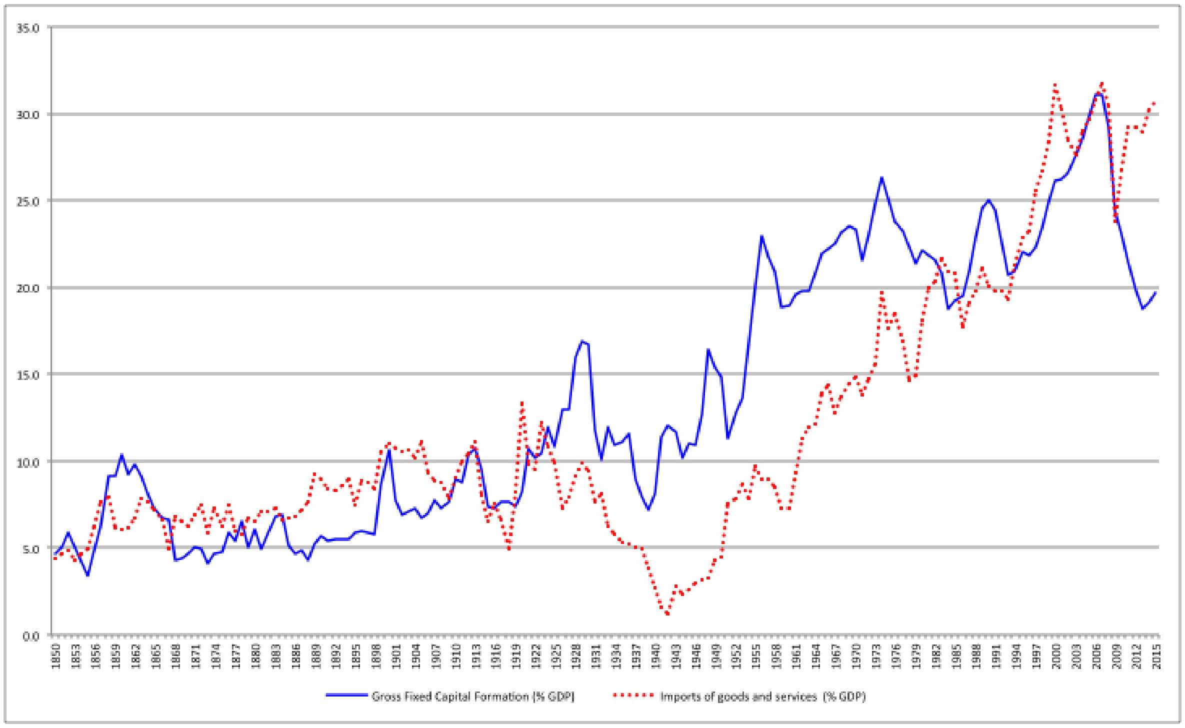

Figure 6. Gross Fixed Capital Formation and Imports, 1850-2015 8% GDP) (current prices)

The composition of GDP by sectors of economic activity between 1850 and 2015 highlights the transformations associated with modern economic growth (Figure 7).

Agriculture's share underwent a sustained contraction over time, but for the autarkic reversal of the 1940s, which intensified during the late 1880s and early 1890s, the 1920s and 1950-1980. Industry, including manufacturing, extractive industries, and utilities, followed an inverse U, expanding its relative size up to the late 1920s and, after the 1930s and 1940s backlash, resumed its relative increase to stabilize at a high plateau (around 30 per cent of GDP), and, then, dropping sharply since the mid-1980s, as sheltered and uncompetitive industries collapsed due to liberalization and opening up after EU accession. By 2010, the relative size of industry had shrunk to practically one-half of its peak in the early 1960s. Construction industry remained stable below 5 per cent of GDP until mid-twentieth century (but for expansionary phases in the late 1850s-early 1860s, 1920s and 1950s), exhibiting a sustained increase since the early 1960s that peaked during the mid-2000s, more than doubling its relative size. The end of the construction bubble during the Great Recession implied a return to the mid-1960s.

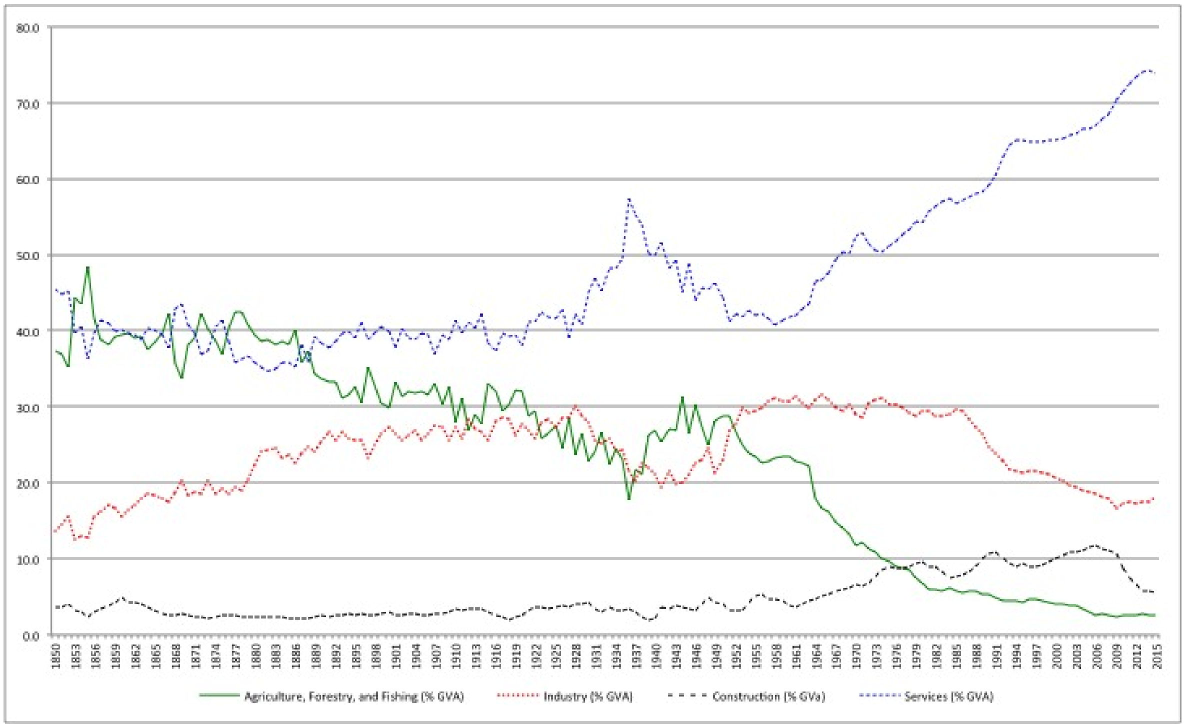

Figure 7. GDP Composition from the Output Side (%) (current prices)

Services made a high and stable contribution to GDP, fluctuating around 40 per cent, between mid-nineteenth and mid-twentieth century, but for the 1930s-1940s parenthesis of depression, civil war, and autarky, and expanded from less than one-half to three-fourths of GDP between the early 1960s and 2015.

The evolution of services as a share of GDP in Spain, with a high share of GDP in early stages of development (around 40 per cent) conflicts with the literature on structural change, which suggests a growing contribution of services to GDP as per capita income increases (Chenery and Syrquin, 1975; Prados de la Escosura, 2007a). A path dependency explanation could be suggested as the arrival of American silver remittances in the early modern era (sixteenth and eighteenth centuries), altered the relative prices of tradable and non-tradable goods, in an early experience of 'Dutch disease', shifting domestic resources towards non-tradables production (Forsyth and Nicholas, 1983; Drelichman, 2005).[4]

[4] As the rise of the metropolis' price level favoured the importation of tradable goods and provoked the dissolution of local industry, while the price increase stimulated the production of goods that were not traded internationally.

Comparing the sectoral composition of GDP to that of labour can be illuminating. Figure 8 presents the composition of employment in terms of hours worked across industries.

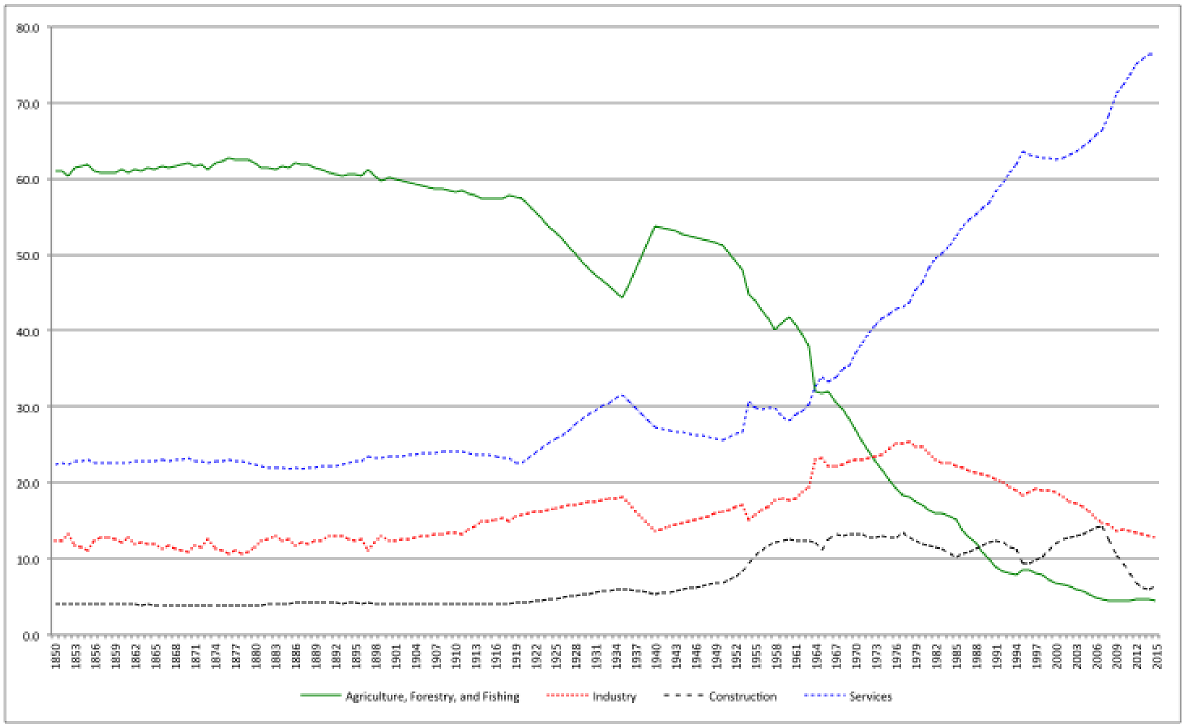

Figure 8. Hours worked by full-time equivalent workers: distribution by economic sectors, 1850-2015

Agriculture's share exhibits a long-run decline from above three-fifths to less than 5 per cent since 2006. It fell more gradually up to 1950 -but for the sharp contraction of the 1920s and early 1930s-, reverted during the Civil War (1936-39) and its autarkic aftermath, and accelerated over 1950-1990, when it shrank from half the labour force to one-tenth. Even though its numbers might be over-exaggerated prior to mid-twentieth century due to peasants' economic activities outside agriculture, agriculture provides the largest contribution to employment up to 1964, when it still represented one-third of total hours worked. The evolution of the relative size of services, whose figures may be underestimated before 1950, for the same reasons of agriculture's over-exaggeration, presents a mirror image of agriculture's, taking over as the largest industry from 1965 onwards and reaching three-fourths of total hours worked by 2015. Industry's steady expansion, but for the Civil War reversal, overcame agriculture's share by 1973 and peaked by the late 1970s reaching one-forth of employment, to initiate a gradual contraction that has cut its relative size by almost half by 2015. Construction, in turn, more than trebled its initial share by 2007, sharply contracting as the sector's bubble ended during the Great Recession.

As already observed in GDP composition, an initial phase of structural change, in which the agricultural sector contracted and that of industry expanded -only broken by the postwar falling behind-, was followed by a second phase since 1980, in which the relative decline involved, in addition to agriculture, the industrial sector, while employment in services accelerated its escalation.

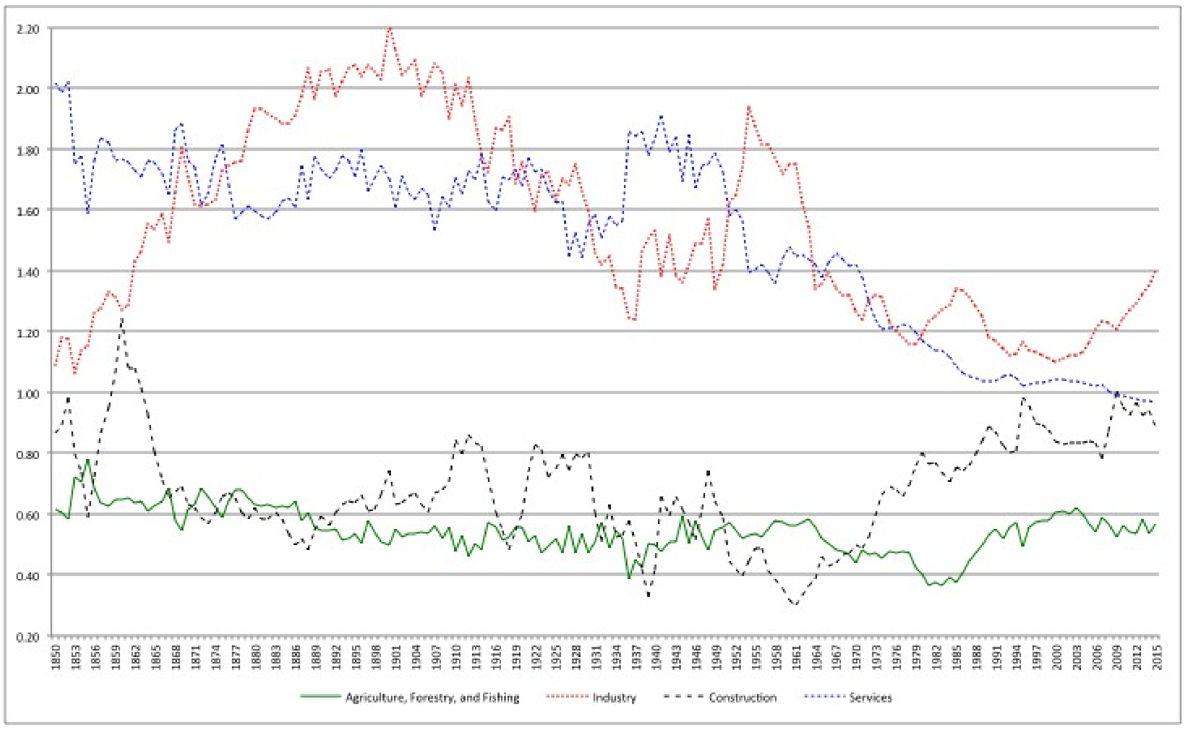

Figure 9. Relative Labour Productivity (GVA per hour worked), 1850-2015 (average labour productivity = 1)

Comparing the sectoral distribution of GDP and employment allows us to establish labour productivity by industry relative to the economy as a whole (Figure 9). Several features stand out. Relative industrial productivity increased to reach a plateau over the late 1880s and World War I in which it doubled it. Episodes of intensified industrialization and urbanization in the 1920s and, to a larger extent, between the mid 1950s and mid-

1970s, were accompanied by absortion of labour, which underlies the decline in the relative productivity of industry and services.

Agricultural labour productivity fluctuated between one-half and two-third of the economy's average (exceptional peaks and troughs aside) and tended to be rather stable. Such stability between 1890 and 1960, hardly affected by the gradual contraction of agricultural share in employment, shows the moderate and gradual structural transformation of the Spanish economy. Later, accelerated industrialization, upheld by capital intensification and the incorporation of new technologies, in the 1960s, and industrial re-structuring in the late 1970s, explain the sharp drop in the relative productivity of the agricultural sector. In turn, the destruction of agricultural employment, which cut its share by half, underlies the recovery of agriculture's relative productivity between 1984 and 1994.

The gradual reduction in productivity differences across during the last half a century suggests convergence in factor proportions and could be interpreted as a result of improved resource allocation.[5]

II.2 GDP per Head

Modern economic growth is defined by sustained improvement in GDP per head. From 1850 to 2015 real GDP per head in Spain experienced nearly a 16-fold increase, growing at an annual rate of 1.7 percent (Figure 10 and Table 1). Such an improvement took place at an uneven pace. Per capita GDP grew at 0.7 per cent over 1850-1950, doubling its initial level. During the next quarter of a century, the Golden Age, its pace accelerated more than 7-fold, so by 1974 per capita income was 3.6 times higher than in 1950. Although the economy decelerated from 1974 onwards, and its rate of growth per head shrank to one-half that of the Golden Age, per capita GDP more than doubled between 1974 and 2007. The Great Recession (2008-13) shrank per capita income by 11 per cent, but, by 2015, its level was still 83 per cent higher than at the time of Spain's EU accession (1985).

[5] Still, the high relative labour productivity of services during the hundred years spanning 1850-1950 calls for a revision of the sectoral distribution of employment and could be ventured that a more rigorous calculation would reveal a lesser proportion of employment in agriculture and a greater one in services, with consequent repercussions on the relative productivity of labour in each sector.

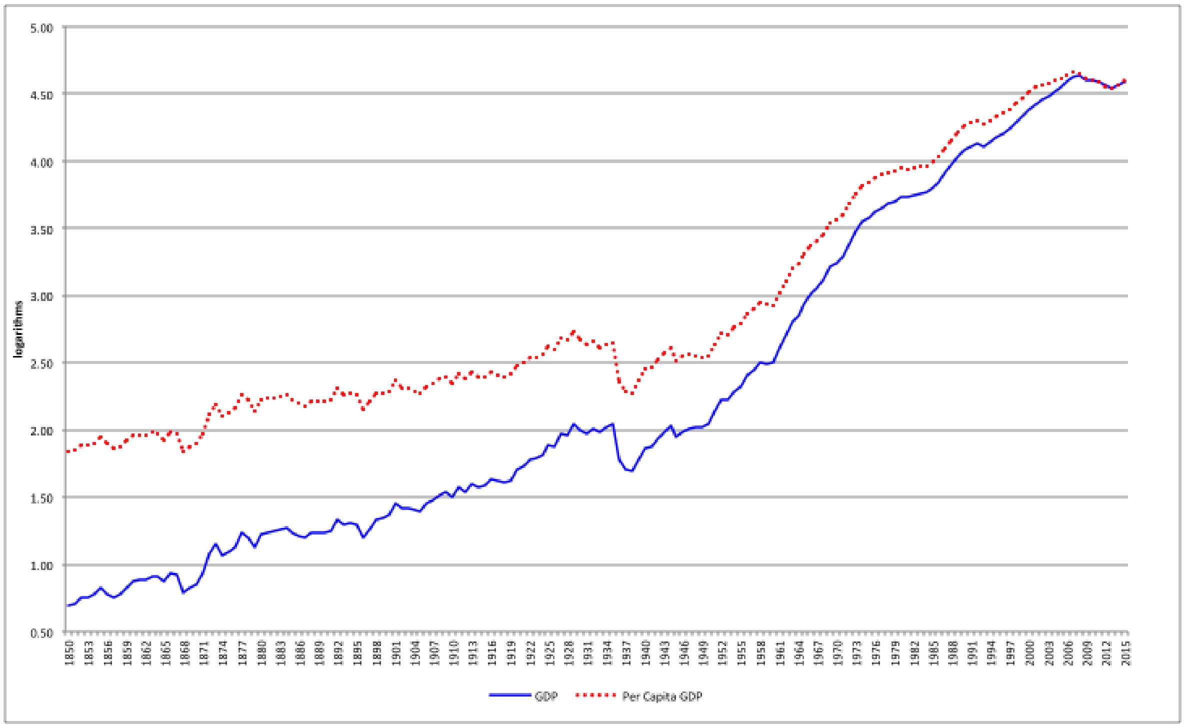

Figure 10. Real GDP and GDP per Head, 1850-2015 (2010=100) (logs).

Different long swings can be distinguished in which growth rates deviate from the long-run trend as a result of economic policies, access to international markets, and technological change. Growth rates, measured as average annual logarithmic rates of variation, are provided in Table 1 for main phases of economic performance (Panel A) and long swings (Panel B). A further breakdown into short cycles is presented for 1850-1950 (Panel C).

During the first long swing, 1850-1883, the rate of growth of product per person was well above the 1850-1950 average. It can be partly attributed to a 'reconstruction effect' after wars, political instability and social unrest during the early nineteenth century. Institutional reforms that brought higher economic freedom seem to lie beneath the significant growth experienced during these three decades (Prados de la Escosura, 2016a). Opening up to international trade and foreign capital made it possible to break the close connection between investment and savings and contributed to the economic growth (Prados de la Escosura, 2010). It is worth stressing that, contrary to common economic wisdom, robust economic performance took place even though political instability prevailed throughout this period -which included the 1854 liberal uprising and the 1868 Glorious Revolution-, suggesting that an improved definition and enforcement of property rights and economic freedom more than offset political turmoil and social unrest.

Table 1
Economic Growth, 1850-2015 (%)
(average yearly logarithmic rates)

	GDP	Per Capita GDP	Population
1850-2015	2.4	1.7	0.7
Panel A			
1850-1950	1.3	0.7	0.6
1950-1974	6.3	5.3	1.0
1974-2007	3.3	2.5	0.7
2007-2015	-0.5	-0.8	0.3
Panel B			
1850-1883	1.7	1.3	0.5
1883-1920	1.2	0.6	0.6
1920-1929	3.8	2.8	1.0
1929-1950	0.0	-0.9	0.9
1950-1958	5.8	5.0	0.8
1958-1974	6.5	5.5	1.1
1974-1984	2.2	1.4	0.8
1984-1992	4.5	4.2	0.3
1992-2007	3.3	2.4	1.0
2007-2013	-1.4	-1.9	0.5
2013-2015	2.4	2.6	-0.2
Panel C			
1850-1855	2.6	2.1	0.6
1855-1866	1.0	0.4	0.6
1866-1873	3.2	2.9	0.2
1873-1883	1.1	0.6	0.5
1883-1892	0.8	0.6	0.3
1892-1901	1.3	0.7	0.6
1901-1913	1.2	0.5	0.7
1913-1918	0.3	-0.6	0.9
1918-1929	3.9	3.1	0.9
1929-1935	0.0	-1.5	1.5
1935-1939	-6.6	-6.9	0.4
1939-1944	4.9	4.8	0.1
1944-1950	0.2	-1.0	1.2

Growth slowed down between the early 1880s and 1920. Restrictions on both domestic and external competition help explain sluggish growth despite institutional stability during the *Restauración* (1875-1923) should have provided a favourable environment for investment and growth (Fraile Balbín, 1991, 1998). Increasing tariff protection (Tena Junguito, 1999), together with exclusion from the prevailing international monetary system, the gold standard, may have represented a major obstacle to Spain's integration in the international economy (Martín-Aceña, 1993; Bordo and Rockoff, 1996). The Cuban War of Independence, despite the already weakened economic links between the Spain and its colony, caused significant macroeconomic instability that brought forward the fall of the peseta and increased Spain's economic isolation (Prados de la Escosura, 2010). Cuban independence had little direct economic impact on Spain's economy but a deep indirect one, as the intensification of protectionist and isolationist tendencies in the early twentieth century seem to be its political outcome (Fraile Balbín and Escribano, 1998). Macroeconomic instability together with a sudden stop reduced capital inflows leading to the depreciation of the Peseta (Martín-Aceña, 1993; Prados de la Escosura, 2010) that, in turn, increased migration costs, reducing the outward flow of labour (Sánchez-Alonso, 2000). World War I hardly brought any economic progress and GDP per head shrank, a result in stark contradiction with the conventional stress on the war stimulating effects on growth.[6]

The 1920s represented the period of most intense growth prior to 1950. The hypothesis that Government intervention, through trade protectionism, regulation, and investment in infrastructure, was a driver of growth has been widely accepted (Velarde, 1969). The emphasis on tariff protectionism tends to neglect, however, that Spain opened up to international capital during the 1920s, which allowed the purchase of capital goods and raw materials and contributed to growth acceleration.

A fourth long swing took place between 1929 and 1950, which includes the Great Depression, the Civil War, and post-war autarkic policies, is defined by economic stagnation and shrinking GDP per head. The Depression, as measured by real GDP per head contraction, extended in Spain, as in the U.S., until 1933, with a 12 per cent fall (against 31 per cent in the U.S.), lasting longer than in the U.K. (where it ended in 1931

[6] Cf. Roldán and García Delgado (1973) for the established view on the impact of the Great War on Spain.

and real per capita GDP per head shrank by 7 per cent) and Germany (1932 and 17 per cent decline, respectively), but less than in Italy (1934 and 9 per cent contraction) and France (1935 and 13 per cent fall). Thus, the Depression, with GDP per head falling at -3.1 per cent annually (-1.5 per cent for absolute GDP), was milder than in the U.S. but similar in intensity to Western Europe's average (Maddison Project, 2013), a finding that challenges the view of a weaker impact due to Spain's relative international isolation and backwardness. The Civil War (1936-39) prevented Spain from joining the post-Depression recovery and resulted in a severe contraction of economic activity (31 per cent drop in real per capita income between levels in 1935 and the 1938 trough) that, nonetheless, did not reach the magnitude of World War II impact on main belligerent countries of continental western Europe (in Austria, the Netherlands, France, and Italy per capita income shrank by half and in Germany by two-thirds) (Maddison Project, 2013).[7]

The weak recovery of the years from 1944 to 1950 stands out in the international context. Spain's economy did not reach its pre-war GDP per head peak level (1929) until 1954 (1950 in absolute terms) and that of private consumption per head until 1956. In contrast, it only took an average of 6 years to return to the pre-war levels in Western Europe (1951).[8] It is true that warring countries surrounded post-Civil War Spain (Velarde, 1993), but the fact that its economy only grew at a rate of 0.2 per cent yearly between 1944 and 1950 suggests a sluggish recovery after a comparatively mild contraction.

In the search for explanations, the destruction of physical capital does not appear to be a convincing one as it was about the Western European average during World War II (around 8 per cent of the existing *stock* of capital in 1935), although its concentration on productive capital (especially transport equipment) meant that levels of destruction caused by the conflict in Spain were far from negligible (Prados de la Escosura and Rosés, 2010a). However, exile after the Civil War and, possibly to a larger extent, internal exile resulting from political repression of Franco's dictatorship, meant the loss of a

[7] Actually, at the trough during the Civil War (1938) Spain's GDP per head was equal to that of 1905, while the World War II trough brought Italy, Germany, and France's back to 1880, 1886, and 1891, respectively (Maddison Project, 2013. See Bolt and van Zanden, 2014, for a presentation of this collaborative project).
[8] Belgium, the Netherlands and France did so in 1949, Austria and Italy in 1950, with Germany (1954) and Greece (1956), the exceptions.

considerable amount of Spain's limited human capital (Núñez 2003, Ortega and Silvestre 2006).[9] Thus, it can be put forward the hypothesis that the larger loss of human capital vis-à-vis physical capital contributed to the delayed reconstruction (Prados de la Escosura, 2007b).

The change in trend that began after 1950 ushered in an exceptional phase of rapid growth lasting until 1974. During the 1950s, though, industrialisation in Spain was largely dependent on internal demand. Import volatility rendered investment risky and tended to penalise capital accumulation, while inflows of foreign capital and new technology were restricted. In a way, Spain's case supports the *counterfactual* that without the Marshall Plan, Inter-war commodity and factor markets intervention, including quantitative restrictions on international trade and exchange controls would have persisted as the main economic policies.[10] An institutional reform initiated with the 1959 Stabilization and Liberalization Plan, a response to the exhaustion of the inward-looking development strategy, set policies that favoured the allocation of resources along comparative advantage and allowed sustained and faster growth during the 1960s and early 1970s.[11] Without the Stabilization and Liberalisation Plan, per capita GDP would have been significantly lower at the time of Franco's death, in 1975. However, without the moderate reforms of the 1950s and the subsequent economic growth it seems unlikely the *Stabilization Plan* would have succeeded (Prados de la Escosura et al., 2012). This view challenges the widespread perception of the first two decades of Franco's dictatorship as a homogeneous autarchic era and the 1959 Stabilization and Liberalization Plan as a major discontinuity between autarky and the market economy.

[9] Regarding interior and exterior exile cf. López (1991, 1996) and Plá Brugat (1994, 1999).

[10] Eichengreen and Uzan (1992) suggest that the Marshall Plan's main contribution was encouraging a pro-market economic policy. Calvo González (2001, 2007) has shown that in Spain there are similarities between the incentives for the market to operate as a mechanism of resource allocation provided by the USA-Spain agreements of 1953 and the Marshall Plan in Europe.

[11] It is worth pointing out interesting similarities between the 1959 Stabilization Plan and the Washington Consensus, including measures conducive to trade and capital account liberalization, macroeconomic policies to reduce inflation and the size of the fiscal imbalances, and other reforms to protect private property rights and to reduce the activity of the government (Williamson, 1990; Fischer, 2003; Schleifer, 2009; and Edwards, 2009).

The oil shocks of the 1970s happened at the time of Spain's transition from dictatorship to democracy that brought with it further opening up and economic liberalization. During the transition decade (1974-1984) GDP growth rate fell to one-third of that achieved over 1958-74, and to one-fourth when measured in per capita terms. Was the slowdown exogenous, a result of the international crisis? Did it derive from the Francoism legacy of an economy still sheltered from international competition? Or was the outcome of the new democratic authorities' policies? Answering these questions represents a challenge to researchers. Accession to the European Union heralded more than three decades of absolute and per capita growth that came to a halt with the Great Recession. Again, the deeper contraction and weaker recovery calls for investigation on the underlying foundations of the 1985-2007 expansion.

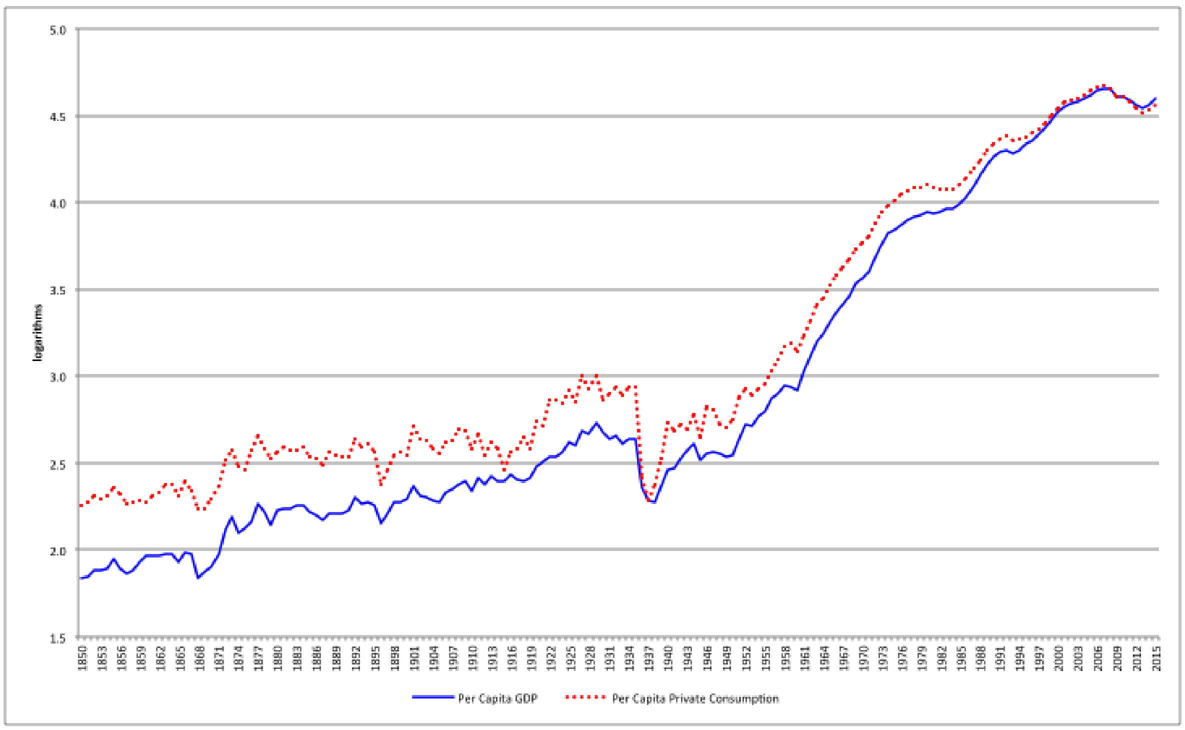

Figure 11. Real Per Capita GDP and Private Consumption, 1850-2015 (2010=100) (logs)

But to what extent did GDP per head gains affect living standards? A look a private consumption per person offers a partial answer (leaving distribution aside). A narrow parallelism emerges between the behaviour of GDP and private consumption per head, the latter at a lower rate, as reflected by its declining contribution to GDP (Figure 11).

Solely during the long decade preceding World War I and the Civil War (1936-39) did private consumption growth ostensibly fall behind that of GDP. In short, it can be claimed that the fruits of growth were passed on to the population so present private consumption was not sacrificed to greater future consumption and, hence, no parallelism can be drawn with the experiences of East Asian countries (Young, 1995).

II.3 Labour Productivity

The evolution of GDP per head can be further decomposed into labour productivity and the amount of labour used per person. Thus, GDP per person (GDP/N) can be expressed as GDP per hour worked (GDP/H), a measure of labour productivity, and the number of hours worked per person (H/N), a measure of effort.

$$GDP/N = GDP/H * H/N \qquad (1)$$

And using low case to denote rates of variation,

$$(gdp/n) = (gdp/h) + (h/n) \qquad (2)$$

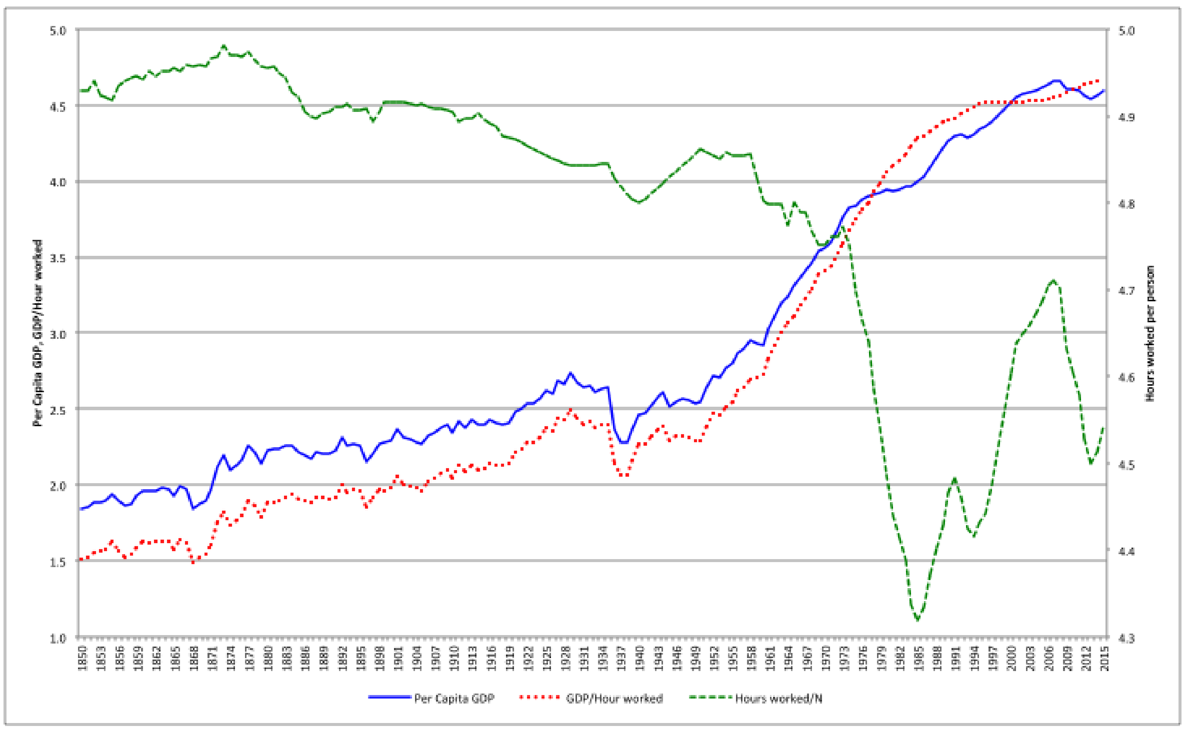

Figure 12. Per Capita GDP and its Components, 1850-2015 (logs)

GDP per head and per hour worked evolved alongside over 1850-2015, even though labour productivity grew at a faster pace –labour productivity increased 23-fold against nearly 16-fold by GDP per head- as the amounts of hours worked per person shrank -from about 1,000 hours per person-year to less than 700- (Table 2 and Figure 12). Thus, it can be claimed that gains in output per head are attributable to productivity gains, with phases of accelerating GDP per head, such as the 1920s or the Golden Age (1950-1974), matching those of faster labour productivity growth.

Table 2

GDP per Head Growth and its Components, 1850-2015 (%)

(average yearly logarithmic rates)

	Per Capita GDP	**GDP/Hour**	**Hours/ Population**
1850-2015	1.7	1.9	-0.2
Panel A			
1850-1950	0.7	0.8	-0.1
1950-1974	5.3	5.8	-0.5
1974-2007	2.5	2.7	-0.1
2007-2015	-0.8	1.3	-2.1
Panel B			
1850-1883	1.3	1.2	0.0
1883-1920	0.6	0.8	-0.2
1920-1929	2.8	3.1	-0.3
1929-1950	-0.9	-1.0	0.1
1950-1958	5.0	5.1	-0.1
1958-1974	5.5	6.1	-0.7
1974-1984	1.4	5.6	-4.1
1984-1992	4.2	2.7	1.5
1992-2007	2.4	0.7	1.7
2007-2013	-1.9	1.6	-3.5
2013-2015	2.6	0.5	2.1
Panel C			
1850-1855	2.1	2.3	-0.2
1855-1866	0.4	0.1	0.3
1866-1873	2.9	2.5	0.4
1873-1883	0.6	1.0	-0.4
1883-1892	0.6	0.9	-0.4
1892-1901	0.7	0.6	0.1
1901-1913	0.5	0.7	-0.2
1913-1918	-0.6	-0.2	-0.4
1918-1929	3.1	3.4	-0.3
1929-1935	-1.5	-1.6	0.0
1935-1939	-6.9	-5.9	-1.0
1939-1944	4.8	4.5	0.4
1944-1950	-1.0	-1.6	0.7

A closer look at the last four decades reveals, however, significant discrepancies over long swings. In fact, a pattern can be observed according to which phases of acceleration in labour productivity correspond to those of GDP per person slowdown, and viceversa. Thus, periods of sluggish (1974-84) or negative (2007-13) per capita GDP growth paralleled episodes of vigorous or recovering productivity growth, although only in the first case, during the 'transition to democracy' decade, labour productivity offset the sharp contraction in hours worked –resulting from unemployment- and prevented a decline in GDP per head. Conversely, the years between Spain's accession to the European Union (1985) and the eve of the Great Recesion (2007), particularly since 1992, exhibited substantial per capita GDP gains while labour productivity slowed down. Thus, during the three decades after Spain joined the EU, in which GDP per head doubled, growing at 3.0 per cent per year, more than half was contributed by the increase in hours worked per person. Thus, it can be concluded that since the mid-1970s the Spanish economy has been unable to combine employment and productivity growth, with the implication that sectors that expanded and created new jobs (mostly in construction and services) were less successful in attracting investment and technological innovation. Actually, labour productivity in construction and services grew at a yearly rate of -0.2 and 0.3 per cent, respectively, compared to 1.1 per cent for the overall economy over 1985-2007.

Gains in aggregate labour productivity can be broken down into the contribution made by the increase in output per hour worked in each economic sector (internal productivity) and by the shift of labour from less productive to more productive sectors (structural change).[12] The level of aggregate labour productivity (A), which is obtained by dividing Gross Value Added (GVA) by the number of hours worked (H) for the economy as a whole in the year t, can be expressed as the result of adding up labour productivity

[12] As correctly pointed out by Matthews, Feinstein and Odling-Smee (1982: 248-254), structural change is not really exogenous as it is caused by the interaction between the supply and demand of resources. Hence, any attempt to establish causal relationships between structural change and growth is flawed**.** From a historical point of view, however, perfect factor mobility does not exist and, consequently differences of marginal productivity between sectors tend to exist, as the movement of resources from one sector to another does not take place automatically. For this reason improvements in resource allocation will contribute to growth during a given period of time. It is also the case that even when marginal productivity is the same in different industries, they will not all grow at the same rate. Growth will depend on their use of technological innovation and the existence of increasing returns.

(GVA_i/H_i) for each economic sector i (i = 1,2, ... n), weighted by each sector's contribution to total hours worked (H_i/H).[13]

$$A_t = (GVA/H)_t = \Sigma\, (GVA_i/H_i)_t\, (H_i/H)_t = \Sigma\, (A_{it}\, U_{it}) \qquad (3)$$

Where A_i is gross value added per hour worked in sector i and U_i is the contribution of sector i to total hours worked.

Using lower case letters to represent rates of change,

$$a_t = \Sigma\, a_{it}\, U_{it} + \Sigma\, A_{it}\, u_{it} \qquad (4)$$

The method usually employed in this calculation, *shift-share analysis,* involves estimating, in the first place, *internal* productivity growth (the first term on the right-hand side of expression (4), that is, the result obtained by adding up the labour productivity growth of GVA per hour worked in each economic sector weighted by the initial composition of employment (expressed in hours worked). The difference between aggregate productivity and *internal* productivity will then provide the contribution of structural change.

This procedure is based on the assumption that, in the absence of labour shift between sectors, each sector's productivity would have been identical to the actual ones. This is an unrealistic assumption when labour is rapidly absorbed by industry and services, productivity in these sectors tends to stagnate or even decline, as it is the case in Spain.[14] It would appear more plausible to assume that agricultural productivity partly improved, say, between 1950 and 1975, due to the reduction in the number of hours worked. Furthermore, during the 'transition to democracy' (1975-85) GVA per hour worked in industry would have grown more slowly had employment not fallen as a result of the industrial restructuring which eliminated less competitive branches. Therefore, in Table 3, the contribution of structural change to the increase in productivity obtained using the conventional *shift-share analysis* represents a *lower* bound.

[13] I draw on Broadberry (1998) in the subsequent paragraphs.

[14] Broadberry (1998) puts forward the idea that if we accept, as proposed by Kindleberger (1967), that labour moving from agriculture to industry and services is surplus labour, then it must be assumed that the hypothetical return of this labour to the agricultural sector would have a negative effect on productivity.

Table 3

Labour Productivity Growth and Structural Change, 1850-2015 (%)

(average yearly logarithmic rates)

	GVA/Hour worked	Internal Productivity (shift-share)	Structural Change Lower bound	Internal Productivity (modified shift-share)	Structural Change Upper bound
1850-2015	1.9	2.1	-0.2	1.2	0.7
Panel A					
1850-1950	0.8	0.5	0.2	0.4	0.3
1950-1974	6.0	5.4	0.6	3.6	2.4
1974-2007	2.5	2.9	-0.4	1.6	0.6
2007-2015	1.4	1.5	-0.1	-0.2	1.6
Panel B					
1850-1883	1.2	1.1	0.1	1.1	0.1
1883-1920	0.8	0.7	0.1	0.6	0.2
1920-1929	2.9	2.5	0.5	1.5	1.5
1929-1950	-1.0	-1.2	0.3	-1.4	0.4
1950-1958	5.0	4.6	0.4	3.0	2.0
1958-1974	6.5	5.9	0.6	4.4	2.1
1974-1984	5.6	5.6	0.0	4.5	1.1
1984-1992	2.1	2.3	-0.3	0.8	1.3
1992-2007	0.6	0.7	-0.1	0.0	0.7
2007-2013	1.8	2.1	-0.2	1.9	0.0
2013-2015	0.1	-0.1	0.1	-0.3	0.4
Panel C					
1850-1855	2.7	2.8	-0.2	2.5	0.1
1855-1866	0.0	-0.1	0.1	-0.1	0.1
1866-1873	2.6	2.6	0.1	2.4	0.3
1873-1883	0.8	0.5	0.3	0.4	0.4
1883-1892	0.9	0.8	0.1	0.7	0.2
1892-1901	0.5	0.5	0.0	0.4	0.1
1901-1913	0.7	0.4	0.3	0.2	0.5
1913-1918	0.3	0.5	-0.2	0.4	-0.1
1918-1929	3.1	2.7	0.4	1.8	1.2
1929-1935	-1.4	-1.4	0.0	-1.4	0.0
1935-1939	-5.8	-5.9	0.2	-8.0	2.2
1939-1944	3.9	4.0	-0.1	3.7	0.2
1944-1950	-1.5	-2.2	0.8	-2.7	1.2

Alternatively, an *upper* bound can be derived using a modified version of *shift-share analysis*.[15] The contribution of structural change is derived by subtracting from aggregate productivity the figure that would result by weighting output per hour worked growth in each sector according to its contribution to total employment in the initial year, but with an exception for those sectors whose contribution to employment falls (for example, agriculture over the entire time span considered and industry since 1975). In such a case, the differential between the rate of variation in hours worked for the economy as a whole and for the relevant sector would be subtracted from the latter's productivity growth.[16] As Table 3 shows, the difference between upper and lower bound can be significant for some periods.

According to the upper bound estimate, structural change would account for 38 per cent of the aggregate productivity growth achieved over the last 166 years. This figure is not far below from Broadberry's findings for Germany and the United States.[17] During the first hundred years under consideration, structural change contributed between one-fourth and two-fifths of labour productivity growh, depending on whether to conventional or modified shift-share is used. A closer look indicates that structural transformation took place between the 1870s and 1929, with 1873-1883, the long decade before World War I and the 1920s as the most intense episodes. According to the modified shift-share, it is in the Golden Age (1950-74) when structural change made the larger and more sustained contribution to productivity growth. Since 1975 and up to the Great Recession structural change accounted for more than one-third of the increase in aggregate labour productivity (upper bound estimate) and avoided an even deeper productivity deceleration after 1984. In this phase, the transfer of labour away from agriculture (which still absorbed one-fifth of the total number of hours worked in 1975 and declined at -4 per cent annually up to 2007) was accompanied by a sustained destruction of employment in

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[15] It provides an upper bound because it does not take into account differences in levels of physical and human capital per worker across economic sectors. Ideally, the contribution of structural change should be calculated in terms of total factor productivity rather than in terms of labour productivity.

[16] Broadberry (1998) suggested this procedure. In this case internal productivity would be calculated as $\Sigma\, a'_{it}\, U_{it}$, where $a'_{it} = a_{it} - (h_t - h_{it})$, if $u_{it} < 0$ (h representing hours worked)

[17] Broadberry (1998: 390) finds that, over 1870-1990, structural change would account for up to 45.7 and 50.3 percent of productivity growth in Germany (1.75 per cent) and the U.S. (1.4 per cent), respectively.

less competitive manufacturing industries, which intensified during the 'transition to democracy' decade (-3.8 per cent yearly decline of hours worked in industry during 1974-84). Again on the basis of the modified shift-share approach, structural change prevented labour productivity from stalling since 2007 and allowed moderate increase in output per hour worked during the Great Recession.

A clearer picture of the evolution of the number of hours worked per person, (H/N), is obtained by breaking it down into its components (Table 4). Thus, (H/N) equals hours worked per full-time equivalent worker, L, (H/L), times the participation rate, -that is, the ratio of L, to the working age population, WAN-, (L/WAN), times the share of WAN in total population, N, (WAN/N),

$$(H/N) = (H/L)^* (L/WAN) * (WAN/N) \qquad (5)$$

That in rates of change (lower case letters), can be expressed as:

$$(h/l) = (h/l) + (l/wan) + (wan/n) \qquad (6)$$

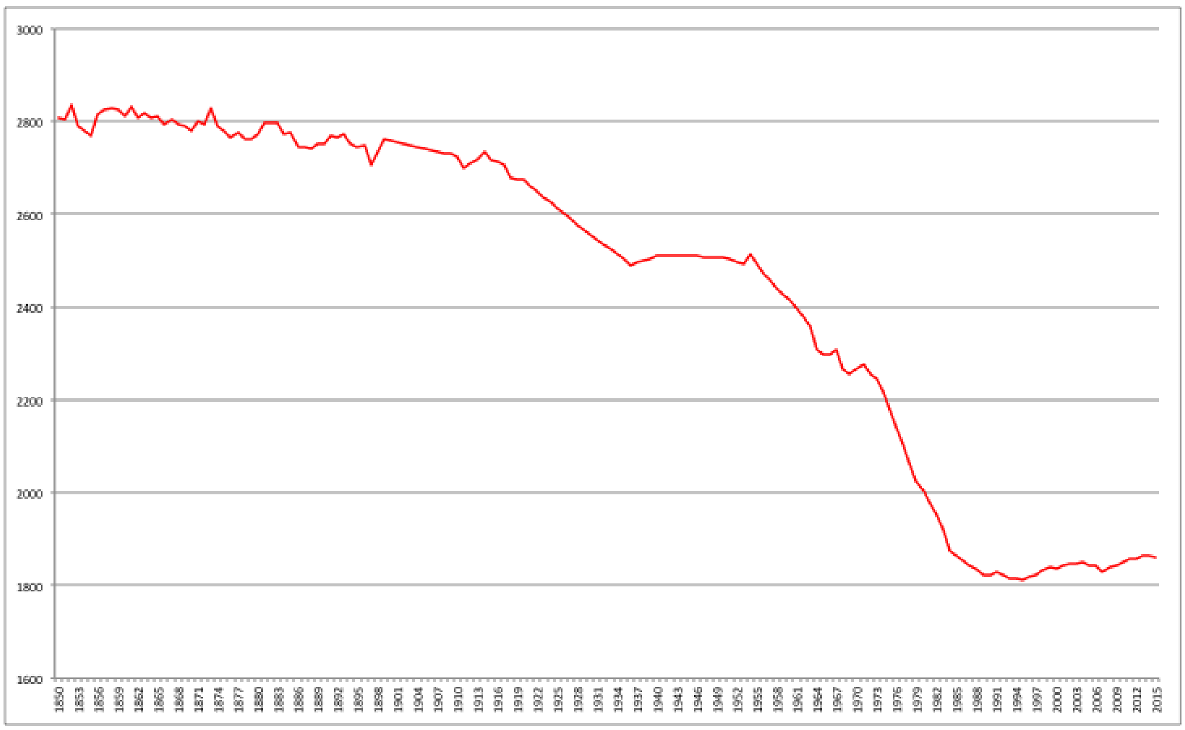

Figure 13. Hours per full-time equivalent worker, 1850-2015

Changes in hours per FTE worker-year, which fell from 2,800 by mid-nineteenth century to less than 1,900 at the beginning of the twentieth-first century represent the main driver of the amount of work per person, especially in periods of industrialization and urbanization such as the 1920s (to which the gradual adoption of the eight hours per day standard also contributed) and the Golden Age (1950-74) (Figure 13).

Table 4

Hours Worked per Head Growth and its Composition, 1850-2015 (%)

(average yearly logarithmic rates)

	Hours worked/N	Hours/FTE worker	FTE worker/WAN	WAN/N
1850-2015	-0.2	-0.3	0.0	0.0
Panel A				
1850-1950	-0.1	-0.1	0.0	0.1
1950-1974	-0.5	-0.5	0.3	-0.3
1974-2007	-0.1	-0.6	0.2	0.3
2007-2015	-2.1	0.2	-1.8	-0.5
Panel B				
1850-1883	0.0	0.0	0.0	0.0
1883-1920	-0.2	-0.1	-0.1	0.0
1920-1929	-0.3	-0.5	0.0	0.1
1929-1950	0.1	-0.1	-0.1	0.3
1950-1958	-0.1	-0.3	0.6	-0.3
1958-1974	-0.7	-0.6	0.2	-0.2
1974-1984	-4.1	-1.7	-2.8	0.3
1984-1992	1.5	-0.4	1.3	0.6
1992-2007	1.7	0.0	1.5	0.2
2007-2013	-3.5	0.3	-3.3	-0.5
2013-2015	2.1	-0.1	2.7	-0.5
Panel C				
1850-1855	-0.2	-0.3	0.0	0.1
1855-1866	0.3	0.1	0.0	0.2
1866-1873	0.4	0.2	0.3	-0.1
1873-1883	-0.4	-0.1	-0.2	-0.1
1883-1892	-0.4	-0.1	-0.2	-0.1
1892-1901	0.1	-0.1	0.1	0.0
1901-1913	-0.2	-0.1	0.0	-0.1
1913-1918	-0.4	-0.3	-0.3	0.1
1918-1929	-0.3	-0.4	0.0	0.1
1929-1935	0.0	-0.4	0.2	0.2
1935-1939	-1.0	0.0	-1.3	0.2
1939-1944	0.4	0.0	-0.1	0.4
1944-1950	0.7	0.0	0.2	0.5

Changes in the participation rate also made a contribution. Thus, in the 1950s, it mitigated the decline in hours worked per person. During the 'transition to democracy' decade (1975-84) the decline in the participation rate, due to dramatic surge in unemployment (largely resulting from the impact of the oil shocks and the exposure to international competition on traditionally sheltered industrial sectors, plus the return of migrants from Europe), explained two-thirds of the contraction of the number of hours worked per person. The remainder was attributable to reduction in hours per worker due to trade unions' higher bargaining power and industrial re-structuring. Again, during the Great Recession (2008-13), another surge in unemployment made participation rate account for most of the contraction in hours worked per person. Conversely, between Spain's EU accession and the Great Recession (1985-2007), the increase in the participation rate was the main contributor (88 per cent) to the increase in the number of hours worked per person, helped by increasing female participation rate and the post-1990 inflow of migrants. Again, the rise in the participation rate, as unemployment has gradually declined, is a main actor in the post-2013 recovery in hours worked per person. Lastly, a demographic gift, as the dependency rate fell increasing the share of potentially active over total population, prevented a further decline of hours worked per person during the 1930s, contributed to its recovery in the 1940s, and helped the surge in employment over 1984-1992.

II.4 Spain's Performance in Comparative Perspective

A long run view of Spain's economic performance cannot be complete without placing it in comparative perspective. In Figure 14 Spain's real GDP per head is presented along estimates for other large Western European countries, Italy, France, the United Kingdom, and Germany, plus the United States, the economic leader that represents the technological frontier, all expressed in purchasing-power-parity adjusted 2011 dollars to allow for countries' differences in price levels (Figure 14).[18] A caveat is needed about this

[18] GDP levels in 2011, converted into 'international' dollars using EKS purchasing power parity (PPP) exchange rates (World Bank, 2013) http://siteresources.worldbank.org/ICPEXT/Resources/ICP_2011.html, have been projected backwards with per capita GDP volume series that, in the case of Spain, correspond to the new historical estimates with post-1958 hybrid linear interpolation. For the rest of countries, volume

kind of exercise. Per capita income levels obtained through backward projection of PPP-adjusted GDP levels for a given benchmark year (2011, as in this case, or 1990 in Maddison's estimates) with volume indices derived at national relative prices provide a convenient way of comparing of countries' levels over time, as it is easy to compute and does not alter national growth rates. However, it also presents a huge index number problem that gets bigger as the time span considered widens rendering comparisons less significant. This is so because the procedure implicitly assumes that the basket of goods and services and the structure of relative prices for the benchmark year remain unaltered over time, something definitively misleading as long run growth is about change in relative prices (Prados de la Escosura, 2000). As a matter of fact, this type of series only provides an effective comparison between the level of the benchmark year (2011 in Figure 14) and that of any other year at the former's relative prices.

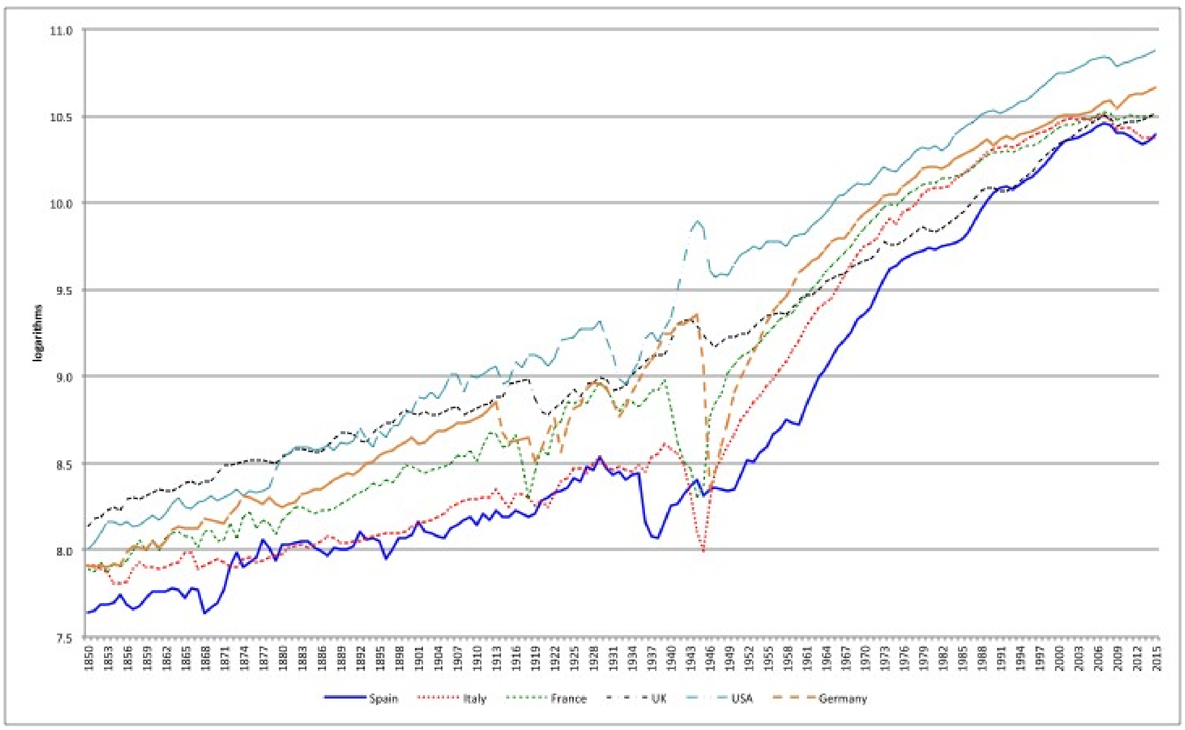

Figure 14. Spain's Comparative Real Per Capita GDP (2011 EKS $) (logs)

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series from the Maddison Project (2013), http://www.ggdc.net/maddison/maddison-project/home.htm, completed with data from Conference Board http://www.conference-board.org/data/economydatabase/.

Several findings emerge from Figure 14. Firstly, Spain's long-term growth appears to be similar to that of western nations.[19] Secondly, Spain's level of GDP per head is systematically lower than other large western European countries. Lastly, the improvement in Spain's GDP per head did not follow a monotonic pattern, a feature that shares with Italy and Germany, and, to less extent, with France, but differs from the steady progress experienced by the U.K. and the U.S.

Table 5
Comparative Per Capita GDP Growth, 1850-2015 (%)
(average annual logarithmic rates)

	Spain	Italy	France	UK	USA	Germany
1850-2015	1.7	1.5	1.6	1.4	1.7	1.7
Panel A						
1850-1913	0.9	0.7	1.2	1.2	1.7	1.5
1913-1950	0.3	0.9	1.1	0.9	1.6	0.2
1950-1973	5.3	5.2	3.9	2.4	2.4	4.9
1973-2007	2.6	1.9	1.6	2.2	1.9	1.6
2007-2015	-0.8	-1.6	-0.2	0.2	0.4	1.1
Panel B						
1850-1883	1.3	0.4	1.1	1.4	1.8	1.2
1883-1913	0.6	1.1	1.4	1.0	1.5	1.8
1913-1918	-0.6	-1.0	-7.5	2.1	1.3	-4.0
1918-1929	3.1	2.2	6.1	0.1	1.8	2.8
1929-1939	-3.7	0.7	0.2	1.3	-0.5	2.9
1939-1950	1.7	0.6	0.7	0.9	3.4	-3.0
1950-1960	3.7	5.4	3.6	2.2	1.7	6.9
1960-1973	6.4	5.0	4.2	2.5	3.0	3.4
1973-1992	2.9	2.5	1.7	1.5	1.8	1.8
1992-2007	2.4	1.2	1.4	2.9	2.0	1.3

The first two results would lend support to the view that the roots of most of today's difference in GDP per person between Spain and advanced countries should be searched for in the pre-1850 era.[20] Nonetheless, a closer look reveals that long-run growth before 1950 was clearly lower in Spain (as in Italy) than in the advanced countries (Table 5). Sluggish growth over 1883-1913 and not taking advantage of its World War I neutrality to catch up, partly account for it. Furthermore, the progress achieved in the 1920s was outweighed by Spain's short-lived recovery from the Depression, brought to a halt by Civil

[19] Alternatively, I have carried out the exercise with the 1990 ICP benchmark estimate favoured by Maddison (and so far by the Maddison Project) with rather similar results.
[20] A new assessment of pre-1850 Spain is provided by Álvarez-Nogal and Prados de la Escosura (2013).

War (1936-39), and a long lasting and weak post-war reconstruction. In fact, although less destructive than World War II, and despite being Spain non-belligerent in World War II, post-Civil War's recovery in Spain was longer and less intense than in the warring western European countries after 1945.

Thus, Spain fell behind between 1850 and 1950 (Figure 15). The second half of the nineteenth century and the early twentieth century witnessed sustained per capita GDP growth while paradoxically the gap with the industrialised countries widened over 1883-1913. Moreover, the gap deepened during the first half of the twentieth century.

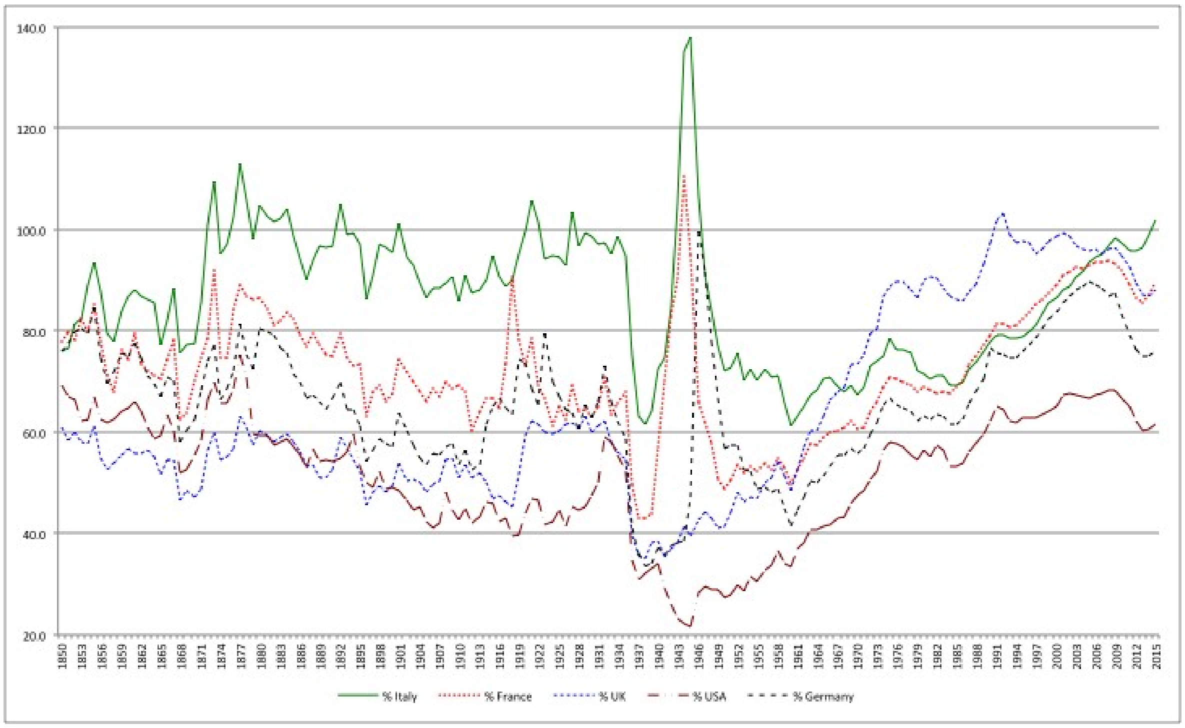

Figure 15. Spain's Relative Real Per Capita GDP (2011 EKS $) (%)

The opposite was true from 1950 to 2007. The Golden Age (1950-73), especially, the period since 1960 (a common feature of countries in the European Periphery: Greece, Portugal, Ireland) stands out as years of outstanding performance and catching up to the advanced nations. Steady, although slower, growth after the transition to democracy years (1974-84), allowed Spain to keep catching up until 2007.

To sum up, the liberal regime of the *Restauración* (1875-1923), which provided political stability, largely failed to offer incentives for accelerated growth; the 1930s and

1940s, with the Civil War and its slow and autarkic recovery; the ‘transition to democracy’ decade after General Franco’s death (1975); and the Great Recession (2008-13), stand out as those phases responsible for Spain’s falling behind Western Europe. Conversely, over 1950-2007, especially during the Golden Age, Spain outperformed the advanced nations improving her relative position. On the whole, Spain’s relative position to western countries has evolved along a wide-U shape, deteriorating to 1950 (except for the 1870s and 1920s) and recovering thereafter (but for the episodes of the transition to democracy and the Great Recession). Thus, at the beginning of the twentieth-first century Spanish real GDP per head represented a similar proportion of US and Germany’s income to the one back in mid-nineteenth century, although had significantly improved with respect to the UK and, kept a similar position to that of the 1870s with regard to France. Lastly, compared to Italy, Spain has reached parity as was also the case in the late nineteenth century and, again, in the 1920s.

A final reminder: the choice of splicing procedure for the modern national accounts can result in far from negligible differences in the relative position of a country over the long run. Furthermore, the differences between the resulting series of interpolation and retropolation procedures appear much more dramatic when placed in a long-run perspective, that is, when the spliced national accounts are projected backwards into the nineteenth century with volume indices taken from historical accounts series. This is due to the fact that most countries, including Spain, grew at a slower pace before 1950, so its per capita GDP level by mid-twentieth century largely determines its earlier relative position in country rankings.

In order to illustrate this point, I have constructed long run estimates of real GDP per head for Spain using for 1958-2015 the retropolated series and placed them along the series obtained through interpolation (Figure 16).[21] It can be observed that when adopting the retropolated series, Spain overcomes Italy in terms of GDP per head over 1850-1950 (but for the Civil War years), matching France and Germany in the early 1880s.

[21] It is worth noting that national accounts series for pre-1970 Italy have been spliced thorugh linear interpolation (Baffigi, 2013).

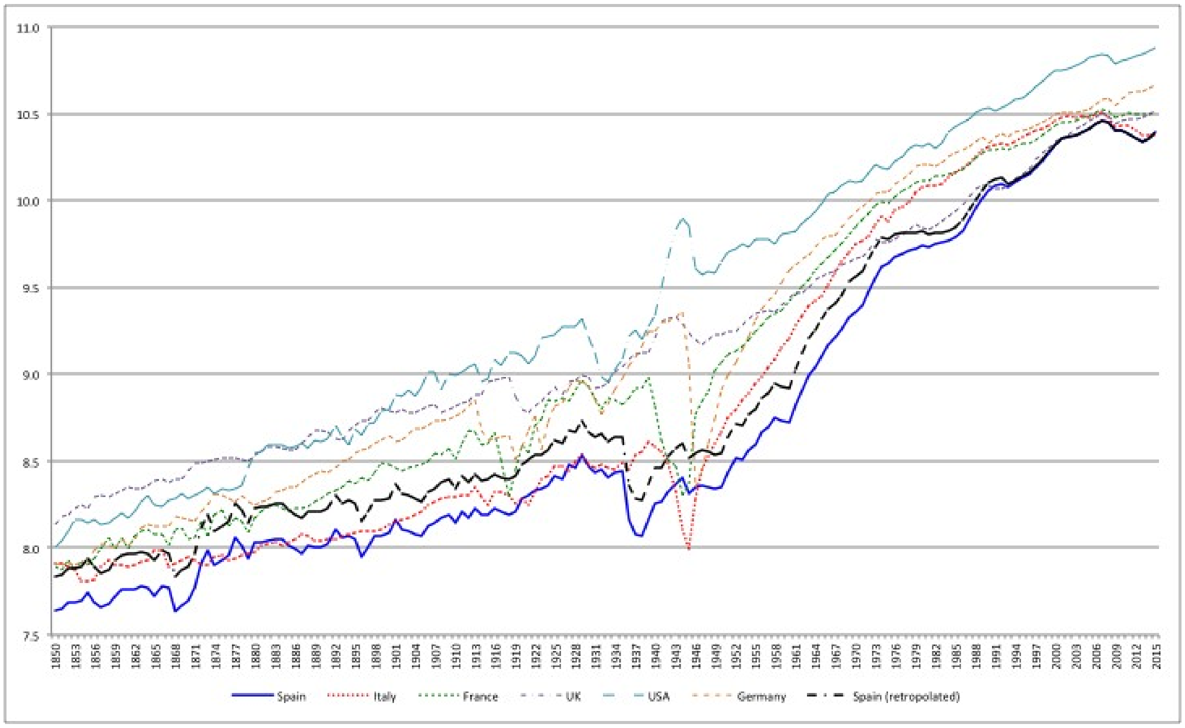

Figure 16 Spain’s Comparative Real Per Capita GDP with Alternative Splicing (2011 EKS $) (logs)

Moreover, I have computed Spain’s position relative to France and the United Kingdom (Figure 17). The choice of yardstick countries obeys to the purpose of comparing a country of fast growth and deep structural change in the second half of the twentieth century, such as Spain, with others more mature and in which economic growth proceeded at a steadier pace. The reason is that it is fast growth and deep structural transformation what produces the large disparities between new and old benchmark national accounts series in the overlapping year. In most countries, national accounts have been spliced through retropolation. However, in these yardstick countries the method of splicing national accounts is not a relevant issue because, as their structural transformation was largely completed before the modern national accounts era (post-World War), differences between new and old national accounts estimates are small at the overlapping year.

According to the figures derived from using the retropolation splicing procedure, during the second half of the nineteenth century, real per capita GDP in Spain would have matched that of France in the mid-1850s and, again, between the mid-1870s and mid-

1880s. Furthermore, when its retropolated series are considered, Spain would have practically matched British per capita income during the last quarter of the twentieth century with a *sorpasso* in 1974 and, again, at the beginning of the 1990s. These results are in stark contrast with those derived by splicing national accounts through interpolation. Thus, Spanish GDP per head would have represented above four-fifths of the French over 1973-84 and would have represented less than 90 per cent of the British with a brief take-over during 1990-93. It can be, then, concluded that whatever the measurement error embodied in the interpolation procedure may be, its results appear far more plausible than those resulting from the conventional retropolation approach.

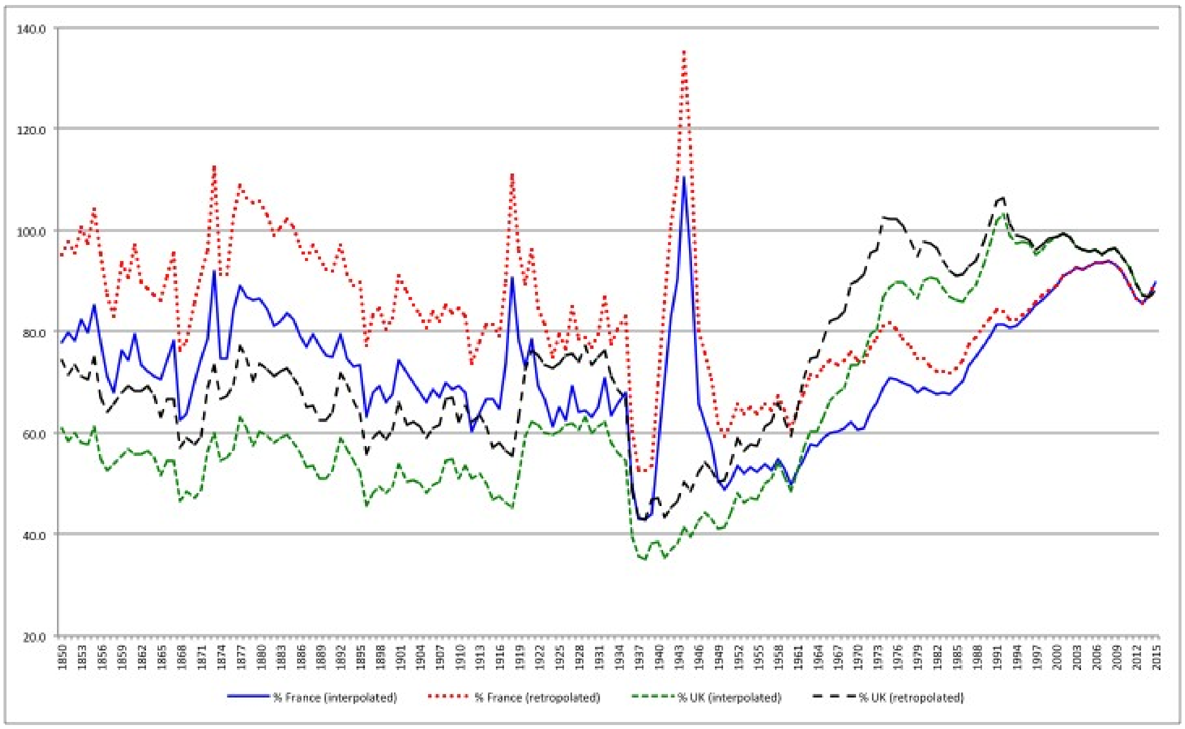

Figure 17 Spain’s Real Per Capita GDP relative to France and the UK with Alternative Splicing (2011 EKS $)

III. MEASURING GDP, 1850-1958: SUPPLY SIDE.

In historical national accounts, as for most developing countries, the most reliable and easiest to estimate GDP figures are those obtained through the production approach.[22] As for most developing countries, real product has been computed from physical indicators rather than as a residual obtained from independently deflated output and inputs. The components' method has prevailed over the indicators' method as much as the data permited it, and both direct and indirect estimating procedures have been employed.[23]

Estimating constant Gross Value Added series involved several steps. In the first place, Laspeyres quantity indices were built up for each major component of output using 1913, 1929 and 1958 value added as alternative weights. Value added for 1913 and 1929 benchmarks was computed either through direct estimate or, more often, gross value added levels for 1958, taken from the input-output table (TIOE58) and the national accounts (CNE58) were projected backwards to 1913 and 1929 (with quantity and price indices expressed as 1958=1). Then, in an attempt to allow for changes in relative prices, these volume indices were spliced into a single series. The estimates with 1913 weights have been accepted for 1850-1913, while variable weighted geometric averages of the indices obtained with 1913 and 1929 (1929 and 1958) weights has been adopted for 1913-1929 (1929-1958), a procedure that allocates a higher weighting to the closer benchmark. Lastly, a volume index of Real Gross Value Added (GVA) for 1850-1958 was constructed by weighting output chain volume Laspeyres indices for each major branch of economic activity with their shares in total gross value added for 1958.

An effort to construct price indices was carried out from a wide range of price series of uneven quality and coverage.[24] Chain Paasche price indices for agriculture, industry and services were built up.**[25]** In fact, since volume indices are of Laspeyres type, that is,

[22] Cf. Heston (1994) for a survey of developing countries GDP estimates.
[23] By a component is meant a variable that is an element of GDP (i.e., agricultural output) and by an indicator a variable that is correlated with real output when the latter is available (i.e., tons-km transported by the railways) (Balke and Gordon, 1989: 41).
[24] Actually, the dearth of data on 19th century prices has prevented economic historians from building price indices, and Sardá (1948) wholesale price index still remains widely used despite general complaints about its low and biased coverage. Available indices for wholesale prices in the early 20th century have not been

$$Q^L = \Sigma q_i p_o / \Sigma q_o p_o, \quad (7)$$

Paasche price indices,

$$P^P = \Sigma q_i p_i / \Sigma q_i p_o, \quad (8)$$

are, then, required to derive current values,

$$V = Q^L * P^P = \Sigma q_i p_i / \Sigma q_o p_o \quad (9)$$

where q and p are quantities and prices at the base year o or any other year i.

Yearly series of gross value added at current prices were derived for each branch of economic activity by projecting backwards its level at the 1958 benchmark, provided by official national accounts (CNE58), with its Laspeyres quantity and Paasche price indices, expressed with reference to 1958 =1.[26] Total Gross Value Added at current prices was derived by aggregation of sectoral value added. An implicit Paasche GVA deflator was calculated by dividing current and constant price series. Adding indirect taxes (net of subsidies) to total current GVA provided nominal GDP at market prices. Real GDP at market prices was obtained by deflating nominal GDP with the GVA deflator.

Four major branches of economic activity are taken into account, a) agriculture, forestry and fishing; b) manufacturing, extractive industries and utilities; c) construction; and d) services.

III.1 Agriculture, Forestry, and Fishing

III.1.1 Agriculture

Two steps were followed in computing agricultural value added.[27] Firstly, final output, that is, total production less seed and animal feed, was constructed. Then, gross

challenged so far (as it is also the case of the price index built by the Comisión del Patrón Oro, Gold Standard Committee, in 1929. Consumer price indices are provided in Reher and Ballesteros (1993), Ballesteros (1997), and Maluquer de Motes (2006, 2013).

[25] Unfortunately, it was not always possible to derive Paasche price indices for every sub-branch of each sector of economic activity. In such a case, Laspeyres chain-indices were used. This problem, resulting from defective statistics, is also common in today's national accounts (Cf. Corrales and Taguas, 1991).

[26] This procedure is most common in present-day developing countries (Heston, 1994: 35). Official national accounts with 1958 base (Contabilidad Nacional de España 1958, CNE58) for the years 1954-1964 are presented in Instituto de Estudios Fiscales (1969).

[27] The Ministry of Agriculture (Ministerio de Agricultura, 1979) computed final output and value added in agriculture for the years 1950-1958. Aggregate national accounts (CNE58), however, are only available since 1954.

value added was derived by substracting purchases of industrial and services inputs, from final output.

Unfortunately, annual data on crops and livestock output are incomplete and their coverage uneven over time. Nonetheless, available data allowed me:

a) To compute agricultural final output at different benchmarks: *circa* 1890, 1898/1902, 1909/13, 1929/33, 1950, and 1960/64 by valuing physical output for each product at farm-gate prices.[28]

b) And, then, to derive, Laspeyres real output (Q^L) for each benchmark (bk) by deflating current values (V) with a Paasche chain price index built on a large sample of agricultural goods (q and p are quantities and prices at the base year o or any other year i).[29] That is,

$$Q^{L}_{bk} = V_{bk} / P_{bk}^{P} \quad bk = 1890, 1898/1902, 1909/13, 1929/33, 1950, 1960 \qquad (10)$$

being P_{bk}^{P} a chain Paasche, $P_{bk}^{P} = \Sigma\, p_{ip}\, q_{ip} / \Sigma\, p_{ip-1}\, q_{ip}$

The lack of quantitative evidence on low acreage, high value crops such as fruits and vegetables that increase its importance at higher income levels and urbanization, makes the deflation of current value estimates a preferable alternative to the construction of volume indices on reduced quantitative information.[30] Actually, prices tend to move together within closer bounds than quantities.[31]

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[28] Unfortunately, since coverage was incomplete, assumptions about the production of several crops in 1890 and 1900 were made. Cf. Table 6. I am indebted to James Simpson for kindly allowing me access to the unpublished agricultural quantity and price data set for 1890-1930 that underlies his own work (Simpson 1994).

[29] Cf. For its coverage, cf. Appendix 2, Table A2.3. It must be noticed that final output and value added series are constructed for the entire period 1850-1958 despite the fact that Ministry of Agriculture's (1979) figures at current prices were preferred for 1950-1958. The reason why the estimate is extended over the 1950s is to dispose of homogeneous deflators over the whole time span.

[30] This is also a common feature of developing countries today, cf. Heston (1994).

[31] There are differences in levels of real final agricultural output between Table 6 and Simpson (1994) that lead to productivity differences. The discrepancies mainly stem from the fact that, in Table 6, a deflator derived from the covered output (that is, goods whose quantities and prices are available) is assumed to be representative for the entire agricultural sector and it is, therefore, used to deflate current final output. Simpson (1994), in turn, assumed that the quantity index that results from the covered output is representative of agriculture as a whole. There is a long-standing debate about which approach is preferable. Cf. Maddison (1995), p. 231-232.

c) Next, real final agricultural output series was derived splicing each pair of adjacent benchmarks with a yearly index of final output built on reduced information.[32] The procedure was to project each benchmark with a quantity index constructed at its relative prices and to compute, then, a weighted geometric average of the series resulting from each pair of adjacent benchmarks, in which the closer benchmark to each particular year was allocated a higher weighting,

$$Q^L_t = (Q^L_{bko} * O^L_t)^{(n-t)/(n-o)} * (Q^L_{bkn} * O^L_t)^{(t-o)/(n-o)} = O^L_t * (Q^L_{bko})^{(n-t)/(n-o)} (Q^L_{bkn})^{(t-o)/(n-o)} \quad (11)$$

where Q is Laspeyres real final output index, O is a Laspeyres quantity index (built on reduced information) for year t, bk represents each benchmark estimate, and o and n are the initial and final years within each period.[33]

d) Lastly, agricultural final output at current prices was obtained by extrapolating the 1958 level of final output (CEN58) backwards with the real final output index and a Paasche price index.[34] The Paasche price index was constructed by interpolating each pair of adjacent chain price benchmarks (Table 6, column 2) with a yearly Paasche price index derived on reduced information.[35] The linkage procedure for each pair of adjacent benchmarks was projecting each benchmark price level with the variations of the annual price index and, then, computing a variable geometric mean in which the closer benchmark to a particular year received the higher weighting.[36]

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[32] That is, on a large sample of agricultural produce. It is worth mentioning that total production at benchmark years over 1891-1931 have already been provided by GEHR (1983) and Simpson (1994). Also, annual quantity indices for total production for 1891-1935 are presented in Comín (1987) and GEHR (1987).

[33] Thus, for 1890-1913, a weighted geometric average of 1891/93 and 1909/13 based quantity indices was taken; for 1913-1929, a weighted geometric average of 1909/13 and 1929/33 based quantity indices; for 1929-1950 a weighted geometric average of 1929/33 and 1950 based quantity indices; and for 1950-1958, a weighted geometric average of 1950 and 1960 based quantity indices. For 1850-1890, in turn, an 1890-based Laspeyres agricultural quantity index was accepted.

[34] The level of agricultural final output derives from Ministerio de Agricultura (1979b: 155).

[35] That is, on the basis of the same variable sample of produce on which the index of final output was constructed.

[36] Thus, for 1890-1913, a weighted geometric average of 1891/93 and 1909/13 based price indices was taken; for 1913-1929, a weighted geometric average of 1909/13 and 1929/33 based price indices; for 1929- 1950 a weighted geometric average of 1929/33 and 1950 based price indices; and for 1950-1958, a weighted geometric average of 1950 and 1960 based price indices. For 1850-1890, in turn, 1890 based Laspeyres agricultural price index was accepted.

Table 6

Agricultural Final Output: Benchmark Estimates, 1890-1960/64

	(1) Current Value (Million Pta)	(2) Paasche Price Chain Index	(3) Laspeyres Volume Chain Index
c. 1890	2,795	89.63	80.76
1898/1902	3,190	95.22	86.77
1909/1913	3,861	100.00	100.00
1929/1933	8,919	173.76	132.96
1950	52,018	1173.27	114.84
1960/1964	156,526[a]	2158.34[b]	187.85[c]

Notes: [a] value at 1960 prices. [b] 1960 price level. [c] 1960 prices.
Incomplete coverage led to assumptions about the production of several crops in 1890 and 1900. Total output for major groups (vegetables, raw materials, fruits and nuts, meat, and poultry and eggs) was inferred on the basis of observed sample-to-total output ratios for 1909/13.
Sources: Quantities, prices and values derive from GEHR (1991), Simpson (1994) (unpublished data set), and the original sources quoted there, and Ministerio de Agricultura (1979a).
Ratios of final output to total production for each crop are shown in Appendix 2, Table A2.1. Coefficients to transform livestock output into quantities of meat, wool and milk are presented in Appendix 2, Table A2.2.

III.1.1.1 *The construction of annual quantity and price indices on reduced information*

The annual quantity and price indices constructed on a sample of agricultural produce, and employed to interpolate adjacent benchmark estimates of real final output, deserve some comments. A two-stage procedure was followed to build the quantity index in order to prevent undesired over-representation of particular crops in aggregate output. Ten groups of products were firstly defined, for which independent indices were constructed. This procedure did not prevent adding guesses to the data since it was assumed that, within each group, those products not included in the sample moved exactly like those that were part of it. However, the more homogeneous the group of goods is, the less strong the implicit assumptions of this method are. In any case, when output is directly estimated from a sample of products, the implicit assumptions are stronger than in my proposed two-stage calculation procedure.[37] Thus, index numbers

[37] Cf. Fenoaltea (1988). Table A2.3, in Appendix 2, presents, for every benchmark-year, the coverage of each group in the annual quantity index. For a more formal description of the method, see the section on industry.

were built for major groups of products: cereals, legumes, vegetables, raw materials, fruits and nuts, must, unrefined olive oil, meat, poultry and eggs, and milk and honey.[38]

Incomplete production data constitute a major obstacle to the construction of an agricultural output index for nineteenth century Spain. Assumptions and conjectures are required, then, to establish trends in agricultural output and to fill in the missing data. Estimating output trends under information constraints can be approached through a) the volume produced, in which most is made of the scattered evidence available; b) the commercialization of crops deflated by the (expanding) length of the transportation network (road and rail) in order to prevent an upwards bias in the rate of growth of agricultural production, as mercantilization evolved faster than production in the early stages of development; and, c) the demand approach, in which output is deducted from an estimate of consumption derived from a demand equation calibrated with levels of disposable income (real wages) and relative prices for food, together with their relevant elasticities.[39] The volume and commercialization approaches are used here to derive output levels.

Data coverage of crop output is much lower prior to 1891 than thereafter, and it is practically non-existent for the period 1850-1881.[40] Output for major agricultural groups had to be derived from scattered information on the production of wheat, barley, must, raw olive oil and sugar cane and beet, plus fruit export data for the period 1882-1890, whose data coverage represents 64 per cent of final production (excluding livestock) in 1890.[41] Up to 1882, non-livestock agricultural output was proxied by trading series for major crops using evidence from maritime and rail transportation (the latter previously

[38] In order to derive each subsectoral index, physical quantities of final output within each group of goods were valued at their benchmark-year prices and the aggregated value expressed in index form. Quantities are derived mostly from GEHR (1989, 1991), completed with Comín (1985a), Simpson (1986, 1994 unpublished data set), and Carreras (1983) for the pre-Civil War years; and Barciela (1989) and Ministerio de Agricultura (1974, 1979a) for 1940-1950. For the Civil War, scant information, only for cereals, is provided in Barciela (1983, 1989) and Almarcha (1975).

[39] Simpson (1994, 1995) followed option a) while Prados de la Escosura (1988) used both a) and c).

[40] Partial evidence for 1857-1860 is collected in Prados de la Escosura (1988).

[41] Output was interpolated for missing years in the cases of wheat (1887) and olive oil (1887 and 1889).

deflated by the network's length).[42] The commercialization series included cereals, legumes, wine, olive oil, fruits and nuts, and raw materials (raw silk, sugar cane).[43] Accepting traded crops as proxies for crops output implies the arguable assumption of a highly commercialized agriculture in which both distribution and production show a similar profile.[44] If trade in in agricultural products rose faster than output, the resulting index would incorporate an upward bias.[45]

Estimates are even weaker for the years 1850-1865, when only maritime transportation data was available (coastal transport since 1857) and in the cases of wheat and legumes output had to be derived from consumption estimates (by arbitrarily assuming a constant consumption per head times population) adjusted for net imports.[46]

Once quantity series were established for the main commodity groups, the calculation procedure used for the post-1865 estimates was applied to compute output.[47]

Evidence on livestock prior to 1905 is only available for 1865 and 1891.[48] Meat and milk output were obtained by applying conversion coefficients to livestock numbers for

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[42] The reason to adjust the traded volume by the length of the network is that this a period of construction of roads and railways that clearly reduced transportation cost and, hence, incentivate commercialization. I am indebted to Albert Carreras for the suggestion.

[43] Specific commercialization series used were transportation by rail (metric tons/km) for cereals (wheat and rice) and wine; and by sea (including coastal and export trade) for wine, olive oil, sugar cane and beet, fruits and nuts. Information (except for fruits and nuts that come from Gallego and Pinilla (1996) and *Estadística(s) del Comercio Exterior*) was derived from Carreras (1983, i, 386-502). Raw wool output was taken from Parejo (1989).

[44] Cf. Simpson (1992a, 1994, 1995) for objections to this point of view, but cf. Federico (1986) for the wide diffusion of the market economy in another nineteenth century Mediterranean agriculture, Italy. Domínguez (1994) research on northern Spain shows that peasants had regular access to the market by mid-nineteenth century.

[45] It is not clear that the relationship between total output and commercialised output were stable over time and it seems reasonable to presume that the gap would decline as the economy developed.

[46] The level of per capita consumption for 1865-1869 was arbitrarily assumed to remain stable over 1850-1865. That is, $D = c * N = (1-s)*Q + (X - M)$,
Where D, is the demand for wheat (legumes), c is its consumption per caput, N is the total population, Q is output, s is the proportion of seed and animal feed, X, exports, and M, imports. Thus, total wheat (legumes) output will be obtained as $Q = (c * N - (X-M)) / (1-s)$
Implicit in this calculation is the assumption that disposable per capita income and agricultural relative prices did not experience significant alterations over these fifteen years and represents a particular case of a demand function.

[47] That is, 1891/93 prices were applied to physical output of each crop and the resulting annual values added up for the previously defined groups of products and expressed in index number form, from which a quantity agricultural index was obtained by weighting them with their shares in the 1890 benchmark.

[48] Less reliable estimates for livestock numbers are available for 1859 and 1888. Cf. Mitchell (1992) for data, and GEHR (1978/1979, 1991) for a critique of the sources.

1865, 1891 and 1905/09 and valued at 1891 prices.[49] Annual figures for livestock output were derived through log-linear interpolation, both for 1865-1891 and 1891-1905. The case for accepting such a crude procedure is to reach a wider coverage for agricultural production by including livestock output, which apparently had an opposite trend to that of crops output over the late 19th century.[50] However, it is worth noticing that a decline in livestock numbers does not necessarily mean that livestock output fell as an increased turnover of animals took place stimulated by the rise in the demand for meat and dairy products associated with urbanization.[51] For the earlier years 1850-1864, output was obtained under the assumption that per caput consumption remained constant and equivalent to that of 1865.[52]

Then, a second step was estimating the aggregate index as a weighted average of output indices for major agricultural groups with their shares in the benchmark's agricultural final output as weights (Table 7). Volume indices were computed for different time spans valuing quantities of each product at the farm-gate prices for each benchmark (Table 8).

[49] Since it has been argued that livestock numbers are underestimated for the 1891-1916 period, conversion coefficients from 1929 and 1933 livestock censuses were adopted (Simpson, 1994; GEHR, 1978/1979, 1991). Animal produce for 1865 was derived from livestock numbers by applying the turnover of animals in García Sanz's (1994). It is noticeable that the percentage of livestock slaughtered changed over the late nineteenth century, in particular for sheep and cattle (Cf. García Sanz, 1994; GEHR, 1983; and Simpson, 1994). Constant average weights per animal in 1920, derived in Flores de Lemus (1926) were accepted in Simpson (1994) and GEHR (1978/1979) and maintained in my estimates since no alternative estimates were available. Coefficients applied are presented in Appendix 2, Table A2.2.

[50] The cautious estimating procedure would, nevertheless, offset the claimed upward bias in growth rates stemming from approximating crops output from traded crops. An additional reason to choose such a rough procedure is that livestock output could be arguably seen as less volatile than crops output and, by its inclusion in the estimate of agricultural output, excess volatility would have been reduced.

[51] Agrarian historians coincide in pointing to a decline in livestock output simultaneous to a rise in crops output over the late 19th century (GEHR, 1978/79, 1983, 1989). The literature does not address, however, the issue of over time change in animals' weight (most authors keep using weights per unit taken from the 1920 census by Flores de Lemus (1926)) and, more significantly, the increased turnover of animals. García Sanz (1994) shows the share of livestock slaughtered in 1865 and its differences with similar estimates for 1900 or 1930 (much closer among themselves) are striking, in particular, for cattle (the proportion in 1865 is, at least, 1 to 3 with respect those of 1904 or 1929), a feature consistent with the rise in urbanization within the period that brought a rise in beef consumption. Mutton consumption rose, in turn, (as sheep became increasingly less oriented towards wool production) and goats' meat experienced a marked decline.

[52] The same procedure used for crops output was applied here. Alternatively, the 1858 livestock census could be used but its noticeable underestimation of livestock numbers prevented me from doing it.

Table 7
Agricultural Final Output at current prices, 1890-1964 (%)

	c.1890	1898/1902	1909/1913	1929/1933	1950	1960/1964[a]
Cereals	27.8	34.4	31.3	25.4	25.6	16.2
Pulses	3.7	3.1	3.3	3.2	3.0	2.0
Vegetables	13.2	13.3	13.1	16.5	17.2	16.4
Raw materials	2.9	3.7	3.3	3.7	3.9	6.8
Fruits and nuts	2.1	7.1	8.3	11.0	11.0	12.7
Wine must	18.5	11.2	6.8	6.3	6.4	4.1
Crude olive oil	7.9	5.8	6.0	5.9	2.6	4.9
Meat	12.4	11.1	13.9	15.5	11.1	14.7
Poultry and eggs	6.3	5.6	7.0	7.1	11.0	8.0
Non-animal	74.7	77.4	70.7	71.2	68.4	62.3
Animal	25.3	22.6	29.3	28.8	31.6	37.7

Note: [a]1960/64 final output computed at 1960 prices.
Sources: Quantities are derived mostly from GEHR (1989, 1991), completed with Comín (1985a), Simpson (1986, 1994) (unpublished data set), and Carreras (1983) for the pre-Civil War years; and Barciela (1989) and Ministerio de Agricultura (1974, 1979a) for the 1940-1964 period. Prices are taken from GEHR (1989), Simpson (1994) (unpublished data set) and Ministerio de Agricultura (1974, 1979a).

To construct a yearly price index, single series for a sample of goods within each agricultural subsector were gathered from a wide range of sources.[53] Individual price series were assembled for cereals (wheat, barley, rice), legumes (chick peas), vegetables (potatoes), fruits and nuts (oranges and almonds), must, unrefined olive oil, raw materials (sugar beet, wool), meat (beef, veal, pig and lamb), eggs and milk. Laspeyres price indices were constructed, then, for each group of goods with benchmarks' weights. An aggregate price index was, in turn, obtained as the average of sub-sectoral Laspeyres price indices weighted by their annual quantity indices.[54]

[53] Sources used for yearly agricultural prices were Arenales (1976), Barciela (1983, 1989), Carreras (1989), Comín (1985a, 1985c), *Estadística(s) de Comercio Exterior* (various years), GEHR (1981a, 1981b, 1989), Gómez Mendoza and Simpson (1988), Martín Rodríguez (1982), Ministerio de Agricultura (1974, 1979a), Ministerio de Trabajo (1942), *Anuarios Estadísticos de España* (various years), Paris Eguilaz (1943), Piqueras (1978), Reher and Ballesteros (1993), Sánchez-Albornoz (1975, 1979, 1981), and Simpson (1994, unpublished data set).
[54] Actually, since quantity indices are of Laspeyres type, price indices should be of Paasche type to derive current values (see expressions (I), (II) and (III) above). It is worth noticing that a hybrid of Laspeyres and Paasche price indices, which stems from defective statistics, is still common in today's national accounts (Cf. Corrales and Taguas, 1991).

Table 8
Construction of Agricultural Volume Indices, 1850-1958

Periods	Benchmark Year	Coverage at Benchmark (%)
1850-1909	1891/93	77.5
1890-1929	1909/13	86.4
1913-1950	1929/33	86.1
1929-1958	1950	86.5
1950-1958	1960	85.1

Sources: Appendix 2, Table A2.3.

III.1.1.2 *Gross value added*

Nominal gross value added was obtained by deducting purchases outside the agricultural sector from final output at current prices. Real gross value added was derived, in turn, by substracting industrial and services inputs at constant prices from real final output. An implicit deflator was derived from nominal and real gross value added series. Purchases outside the agricultural sector were proxied by the consumption of mineral fertilizers and the level of non-agricultural inputs for 1958 was backcasted with the annual rate of variation of mineral fertilizers consumed in agriculture.[55]

III.1.2 Forestry

Evidence for forestry is only available since 1901 and quantities of wood, firewood, resin, cork and esparto grass were valued at 1912/13, 1929/33 and 1960 prices and added up into single values from which a chain quantity index was derived.[56] Output at current prices is available since 1901.[57] Gross value added at current prices was computed

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[55] Fortunately, the small share of agricultural final output represented by purchases outside agriculture keeps the size of the bias introduced by such crude proxies within reasonable limits. The source for the 1958 benchmark was Ministerio de Agricultura (1979b: 155). The $N+P_2O_5+K_2O$ content of mineral fertilizers in Gallego (1986) and Barciela (1989) provides a homogeneous annual indicator for the years 1892-1958 that was backcasted with fertilizer imports to 1850. Missing values for the content of mineral fertilizers in 1935-1939 and 1945-1950 were log-linearly interpolated from available data for 1935, 1945 and 1950. For 1940-1944 it was assumed the same value as for 1945. For mineral fertilizers, prices were taken from Pujol (1998), Carreras (1989) and *Anuario(s) Estadístico(s)*. Quantities and prices for fertilizer imports were derived from *Estadística(s) del Comercio Exterior*.

[56] The index was derived from splicing four sub-indices: 1901-1913, values at 1912/13 prices; 1913-1929, geometric average of values at 1912/13 and 1929/33 prices; 1929-1940, values at 1929/33 prices; 1940-1958, values at 1960 prices. Splicing the sub-series was done using ratios for overlapping years. Sources used were GEHR (1989, 1991), Barciela (1989) and Ministerio de Agricultura (1979a, 1979b).

[57] Reseña Estadística (1952) for the current value of total output, 1901-1950. Current values of total and final output are provided in Ministerio de Agricultura (1979) for 1950-1958

through backward projection of the 1958 level in national accounts (CNE-58) with the value index.[58] An implicit deflator was derived from the current value and volume indices.

III.1.3 Fishing

For fishing, quantity and current value series are available from 1904 onwards but only scattered information exists for 1878, 1883 and 1888-1892 (and no data at all for 1935-39).[59] The quantity of fresh fish captured is available but, since no allowances can be made for composition changes, the alternative of deflating current value of fish captures was preferred on the grounds that, within a given industry, price variance is lower than quantity variance. Gross value added at current prices was obtained through backward extrapolation of the 1958 level (CNE58) with the rate of variation of the total value of captures.[60] When current values of total production were missing (1850-1903), gross value added was extrapolated backwards on the basis of output (computed under the assumption of constant per capita consumption times the population and adjusted for net exports) and a price index for cod.[61] An implicit deflator was derived from the current value and volume indices.

III.1.4 Value Added for Agriculture, Forestry, and Fishing

Value added at current prices for agriculture, forestry and fishing was reached by adding up each subsector's estimates. Aggregate volume indices for agriculture, forestry and fishing output were derived as an average of the sub-sector indices with their share in its aggregate gross value added for 1913, 1929 and 1958 as weights, respectively.[62] Then, a single quantity index was computed as a variable weighted geometric average of the

[58] It was arbitrarily assumed that variations in value added at current prices corresponded to those in total output in nominal terms.
[59] Sources used are Giráldez (1991) for 1883-1934, completed with unpublished data obtained by Gómez Mendoza (1983) for 1878, 1888-92 and 1904-07; and Barciela (1989) for 1940-1958.
[60] The value of total production is considered to provide an acceptable proxy for value added. Cf. Hemberg (1955) and Giráldez (1991), pp. 520-521.
[61] Cod prices in Arenales (1976).
[62] Gross value added for 1958 comes from 1958-based national accounts, CNE58 (I.E.F. (1969). The shares for 1958 were: agriculture, 0.8963; forestry, 0.0722; fishing, 0.0315. For the period 1850-1900 when forestry data is missing, agriculture's share was increased correspondingly. For the Civil War years (1936-39), when no data exist for forestry and fishing I assumed these two sectors evolved as agriculture.

three indices.[63] The composition of the aggregate index is as follows, for 1850-1913, 1913 weights were accepted; for 1913-1929, a weighted geometric average of 1913 and 1929 weighted indices; for 1929-1958 a weighted geometric average of 1929 and 1958 weighted indices. An implicit deflator was obtained from current and constant price value added.

III.2 Industry

New series of industrial output and its main components, in nominal and real terms, are constructed in this section. The pathbreaking research carried out by Albert Carreras supplied the basis from which new series for extractive industries, utilities and manufacturing output were built up.[64]

The difficulties faced by historical attempts to produce hard empirical evidence on industrial performance can be illustrated by assessing Carreras' seminal contribution.[65] His index of industrial production used a fixed weighting system with alternative base years (1913, 1929, 1958, and 1975) that were, in turn, spliced into a single series using end-years. For the period under study here, the 1958 input-output table (TIOE58) supplied the unit value added used as weights that were, then, extrapolated backwards to 1929 and 1913 with industrial prices, under the assumption that they approximated the trends in unit value added.[66] Unfortunately, the author was unable to establish earlier base years for the nineteenth century and, as no regard was paid to changes in relative prices, the further back in time we move from 1913, the less representative of industrial performance his index becomes. In addition to the use of fixed weights, limited coverage is usually a

[63] In the compromise single index, each benchmark's index gets a larger weight the closer it is to each particular year (the formula used is (12)).

[64] Cf. Carreras (1983, 1984, 1990, 1992). Most of the annual data and the weighting system used for this section derive from Carreras (1983).

[65] An alternative estimate can be found in in Prados de la Escosura (1988), chap. 4, in which Fisher indices were computed for 1860, 1890 and 1910 benchmarks using 1856, 1900 and 1920 weights.

[66] The actual procedure followed by Carreras (1983, 1984) to derive unit value added for 1913 and 1929 was applying the ratio of gross value added at factor cost to total value for 1958 to industrial prices in 1913 and 1929, assuming implicitly that such a ratio was stable over time.

major liability for any industrial index. Carreras' index reaches an acceptable coverage, 65 per cent in 1958 and approximately 50 and 70 per cent for 1929 and 1913.[67]

The main objection to Carreras' index is its weighting scheme. At each benchmark (1913, 1929, 1958, and 1975), annual physical output for every product was weighted by its unit value added to compose an aggregate series that was, then, spliced into a single chain index using end years.[68] The final series approximates well overall industrial performance insofar the sample of goods from which the industrial output index is derived remains 'representative' for the whole industry. Unfortunately, the coverage of different sectors is asymmetrical in Carreras' index and, as one moves backwards in time, it declines and becomes more uneven, increasing the risk of undesired over-representation of particular products since a mere fraction of a subsector may eventually dominate the overall index.[69]

Table 9
Composition of Manufacturing Value Added in 1958

	(1)	(2)	(3)
	Carreras simple (%)	**CNE58 (%)**	**Deviation* (%)**
Food, Beverages and Tobacco	18.1	17.0	6
Textile and Clothing	17.1	21.2	-21
Timber, Cork and Furniture	0.4	7.1	-288
Paper and Printing	1.9	4.4	-84
Chemical	4.2	10.2	-89
Stone, Clay, Glass and Cement	1.5	4.4	-108
Metal, basic	12.7	6.2	72
Metal, transformation	35.3	17.3	71
Transport Equipment	5.4	7.6	-34
Other	3.4	4.6	-32

Note: * [100*ln ((1)/(2))]
Sources: Carreras (1983) and Spanish National Accounts Base 1958 (CNE58).

[67] Industrial gross value added used to obtain these per centages derive from contemporary estimates by Vandellòs (1925) for 1913 and de Miguel (1935) for 1927. The coverage of Carreras' industrial production index is still lower than the one by Lewis (1978) for the U.K., which covered 91 per cent of manufacturing and mining value added in 1907.

[68] In Carreras (1987, 1990), the final index results from linking the series for 1831-1913 (built using the 1913 benchmark) with the series for 1913-1935 (1929 benchmark), the series for 1935-1958 (1958 benchmark), and the series 1958-1981 (1975 benchmark).

[69] Cf. Harley (1982) and Fremdling (1988) for a critique of analogous problems in British and German industrial production indices built by Hoffmann (1955). A debate on industrial growth in early 19th century Spain along these lines can be found in Prados de la Escosura (1988), chap. 4 and (1990), chap. 3 (*addenda*). Cf. Rosés (2003) for a re-assessment.

An illustration of this argument is provided by the coverage of Carreras' index at the 1958 benchmark. A glance at Table 9 shows the extent to which its coverage is asymmetrical. Metal industries (basic and transformation), for instance, are clearly over-represented conditioning the aggregate industrial index when it is computed directly, as in Carreras' case. Industrial growth might suffer, then, from an upward bias as a result of over-weighting capital goods, whose growth rate is usually higher than the industry's average.[70] In the construction of quantity indices for manufacturing industry an attempt will be made to prevent some of the shortcomings in Carreras' industrial production index.

III.2.1 Manufacturing

Lack of information prevented the computation of total production and inputs, at current and constant prices, separately, from which nominal and real value added would be derived. In turn, changes in real value added are represented by variations in quantity indices constructed from production evidence for each manufacturing sector, as it is usually done in historical national accounts and occasionally in developing countries.[71]

In order to construct an index for manufacturing output, Laspeyres indices for each branch ($Q_{i,t}$) were, firstly, computed and, then, the aggregate index (Q^*_t) was obtained as their average, using each branch's share in total manufacturing value added at the benchmark year as weights ($P_{i,o}$).[72] That is,

$$Q_{i,t} = \Sigma\, q^i_{jt}\, p^i_{jo} / \Sigma\, q^i_{jo}\, p^i_{jo} \qquad (12)$$ and, then,

$$Q^*_t = \Sigma\, Q_{i,t}\, P_{i,o} / \Sigma\, Q_{i,o}\, P_{i,o} \qquad (13)$$ where,

$$P_{i,o} = \Sigma\, q^i_{jo}\, p^i_{jo} / \Sigma\, q_{jo}\, p_{jo} \qquad (14)$$

Here q and p represent quantities and prices; subscripts o and t are the benchmark year and any other year, respectively; j = 1, ... n, are goods, and i = 1, ... s, are sectors;

[70] However, as Morellá (1992) suggests, the Gerschenkron effect, that is, the downward bias in the growth rate introduced by end-year weigthing, may offset it.

[71] Cf. Holtfrerich (1983) and Fenoaltea (2003, 2005), for German and Italian historical accounts, and Heston (1994: 35, 47), for present-day developing countries. Cf. Gandoy (1988) for a critique of the use of production indices instead of real value added derived as a residual of double deflated output and inputs and David (1962) and Fenoaltea (1976) for support of single deflation.

[72] As it has been shown above, the same method was applied to the construction of the agricultural final output series.

superscript **i** denotes quantities and prices of goods included in sector **i**. Goods in sector **i** are not included in any other sector.

Using this approach, the problem of lack of representativeness will be less acute than in the case of Carreras index, since the assumptions that **a)** total output evolves as its main components, and **b)** its coverage remains unchanged over a given period, are more easily acceptable at branch level than for the industry as a whole.

For manufacturing, eleven branches have been distinguished (Table 10). Basic series of physical quantities were taken from Carreras (1983, 1989), supplemented with production data on wine, alcohol, brandy, beer, meat slaughtering, and timber.[73] Thus, most data employed in the construction of the manufacturing output index correspond to intermediate and primary inputs that would lead, in turn, to underestimating industrial growth, as efficiency gains in the use of inputs are not allowed for. In order to offset this shortcoming I arbitrarily assumed a yearly 0.5 per cent efficiency increase in the use of inputs for engineering industry and incorporated quality adjustments in the transport equipment industry.[74]

In the construction of a Laspeyres quantity index for manufacturing production a two-stage procedure was followed,

a) Quantity indices for each manufacturing branch. Unit value added for each product in 1958 was backward extrapolated to 1929, 1913, 1890 and 1870 with its own price indices under the arbitrary assumption that the value added/total production ratio remained stable over time.[75] Whenever possible direct estimates of unit value added were applied.[76] Also adjustments by Morellá on Carreras' unit value added estimates for 1958 were

[73] Almarcha *et al.* (1975), Coll (1985, 1986), Comín (1985a), together with the reference provided in the section on agriculture above, provide complementary sources.

[74] Lewis (1978) made the same assumption for the U.K. Quality indices for shipbuilding and locomotive production have been applied the tons constructed. For shipbuilding, Feinstein (1988) quality index has been adjusted to the Spanish case. Thus, for 1850-69, no adjustment has been made; a 0.35 per cent annual increase was applied to 1870-85 that rose to 0.7 per cent for 1885-1900 and to 0.83 per cent over 1901-36 while no increase was assumed for 1937-49. Finally, a 1 per cent quality improvement was accepted for 1950-58. For the production of locomotives a quality adjustment has been derived from Cordero and Menéndez (1978) evidence on the increase in power per type of locomotive (including electric and diesel engines).

[75] This is the procedure followed by Carreras (1983) for 1913 and 1929.

[76] Historical estimates for unit value added in mining, cement and metal and engineering industries derived from Coll (1985, 1986), Escudero (1989) and Gómez Mendoza (1984, 1985a, 1985b) were employed.

accepted.[77] Then, for each branch of manufacturing, Laspeyres quantity indices were constructed with each benchmark's unit value added estimates as weights.[78]

b) Quantity index for aggregate manufacturing. A Laspeyres quantity index for total manufacturing was obtained by adding up all branch indices with their benchmark shares in 1913, 1929, and 1958 current value added as weights (Table 10) that were obtained by extrapolation of 1958 levels (CNE58) with each branch's Laspeyres quantity and Paasche price indices. The resulting three indices were, then, spliced using a variable weighted geometric mean, in which the closer to a given year t, the larger the weight allocated to a particular benchmark (as shown in (V)).[79]

Table 10
Breakdown of Manufacturing Value Added, 1913-1958 (%)

	(1)	(2)	(3)
	1913	**1929**	**1958**
Food, Beverages and Tobacco	38.4	29.6	17.0
Textile	18.8	14.4	14.5
Clothing and Shoemaking	10.1	7.0	6.7
Timber, Cork and Furniture	7.6	11.3	7.1
Paper and Printing	2.2	1.7	4.4
Chemical	2.5	4.3	10.2
Stone, Clay, Glass and Cement	0.7	4.4	4.4
Metal, basic	6.0	6.6	6.2
Metal, transformation	6.3	12.7	17.3
Transport Equipment	5.0	6.6	7.6
Other	2.4	1.4	4.6

Sources: CNE58 for 1958; for 1913 and 1929, see text.

77 Cf. Morellá (1992).

78 Thus, each branch or sectoral index was built using 1870 benchmark's unit value added for 1850-1870; indices with 1870 and 1890 unit value added weights for 1870-1890; and 1890 and 1913 unit value added weights for 1890-1913. Then, a geometric mean was calculated for each sub-period and a single sectoral index was reached for 1850-1913 splicing the three segments 1850-70, 1870-90 and 1890-1913 on the basis of overlapping years. For the post-1913 period, branch indices were derived with 1913 and 1929 unit value added for 1913-1929; and with 1929 and 1958 unit value added weights for 1929-1958. I did not follow the common practice in historical industrial accounts of smoothing the resulting series with some sort of moving average in order to allow for stocks (Cf. Batista et al., 1997; Maluquer de Motes, 1994) since I did not have any knowledge about the size and evolution of industrial stocks.

79 Thus, 1913 weighted indices were used for 1850-1913 and variable geometrical averages of 1913 and 1929 based indices, for the years 1913-1929, and of 1929 and 1958 based indices, for 1929-1958.

Paasche price indices for each branch of manufacturing industry were constructed by dividing, for a given sample of goods, its current value (expressed in index form) by a Laspeyres quantity index.[80] Current values for the sample of goods were obtained by multiplying quantities by prices that were, then, added up. An important caveat is that manufacturing price indices were constructed on very scant price data, strongly skewed towards raw materials and intermediate goods that, in turn, would tend to bias upwards current manufacturing value added.[81] Later, an implicit Paasche deflator was obtained for aggregate manufacturing by dividing total current value added (in index form) by the Laspeyres quantity index.

III.2.2 Extractive Industries

As regards extractive industries, mining and quarrying were considered, with the latter usually representing less than 10 per cent of sectoral value added. The construction procedure of quantity and price indices and of nominal and real value added levels was identical to the case of manufacturing.[82]

III.2.3 Utilities

Only gas and electricity output series were available on yearly basis and an aggregate chain index was obtained by weighting gas and electricity output with their

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[80] This implies that goods whose prices were not available were assumed to have the same price behaviour as those within the sample. For manufacturing, price indices for different subsectors (food, textile, shoemaking, metal, chemical, cement, timber, paper) were constructed from a wide variety of sources. Thus, for food industry, its price index was based on price series for wine, brandy, beer, olive oil, flour, rice, sugar, coffee, cocoa and tobacco. Prices for yarn and semi-manufactures of cotton, silk, wool, hemp and jute were, in turn, the basic ingredients of the textile price index. Again, for metal industries, both basic and transforming, iron ingots, steel and cast iron, tin, lead, copper, blister, zinc, tin, silver, and mercury, that is, inputs prices, were the almost exclusive ingredients of their price indices. Prices for shoes, corks, common and Portland cement, paper, were the available information for shoemaking, cork, cement, paper and printing industries. For the chemical industries, a wider coverage was achieved. In any case, price coverage was uneven and the sources quite heterogeneous. The main sources for industrial prices used, including mining, utilities and construction, were Arenales (1976), Barciela (1989), Carreras (1989), Coll (1985, 1986), Martín Rodríguez (1982), Ministerio de Trabajo (1942), Paris Eguilaz (1943), and Prados de la Escosura (1981).

[81] This is so because as efficiency increases, intermediate consumption is reduced rendering, hence, a lower increase (or a sharper decline) for the value added deflator than for inputs prices or for the deflator of total production.

[82] No data were available for quarrying before 1920 and extractive industries' output was backcasted till 1850 with mining output. The sources for quantities and prices were Carreras (1983, 1989), Coll (1985) and Escudero (1998). Coal, iron ore, lead ore, pyrites are the main components of the price index for mining (see note 98).

contributions to sectoral value added for 1913, 1929 and 1958, in which gas was allocated a larger share to include water supply.[83] Nominal gross value added was reached through backwards extrapolation of 1958 levels with Laspeyres quantity and Paasche price indices. Quantity indices were spliced into a single index following the same procedure used for manufacturing and extractive industries. In turn, the same construction method of price indices applied to manufacturing and extractive in dustries was adopted.

III.2.4 Value Added for Manufacturing, Extractive Industries, and Utilities

Finally, an aggregate quantity index for industry (excluding construction) was derived as an average of manufacturing, extractive industries, and utilities indices using their 1913, 1929 and 1958 sectoral shares in industrial gross value added as weights. Then, to obtain a single Laspeyres chain index of industrial gross value added, the three indices were spliced through a variable weighted geometric mean in which weighting varied according to the distance from the considered year (as in (12)). Current price estimates were obtained by adding up each industry's value added. An implicit deflator was derived from current and constant price estimates.

III.3 Construction

Five subsectors were distinguished in the construction industry, residential and commercial, railway, road building, hydraulic infrastructure and other public works.

III.3.1 Residential and Commercial Construction

I started from the available information on the stock of urban and rural dwellings and derived the number built in each inter-censal period by adding a rough estimate of the number of houses demolished in the period to the net increase in the stock.[84] Also size

[83] For water supply no national aggregate figures were found and only scattered data are available for a few capital cities (Madrid (Rueda Laffond, 1994), Barcelona, Bilbao (Antolín, 1991), Pamplona (Garrués, 1998)). For utilities, gas and electricity prices were available (see note 98).
Data for gross value added comes from 1958 national accounts (CNE58) distributed by branches with the 1958 input-output table (IOT58). In allocating a higher weight to gas, to compensate for the lack of data on water supply, I followed a suggestion by Fenoaltea (1982), p. 627.

[84] No distinction can be made between residential and commercial use of dwellings. However, Tafunell (1989b) points out that in 1890's Barcelona non-residential dwellings did not reach 5 per cent of total dwellings, with the ground floor of residential buildings being commonly allocated to industrial and services' activities. The sources are *Nomenclators* and *Censos de viviendas*. Residential construction indices are available for several cities, including Madrid and Barcelona for the late nineteenth and early twentieth

and quality changes in housing were taken into consideration and overall improvements were arbitrarily assumed to take place at 0.5 per cent annually.[85] Demolition rates were obtained through alternative methods that cast very close results. One procedure, adopted from the British case, was to derive decadal rates for demolition by assuming that 85 per cent of the new homes built a century earlier would be demolished while the surviving 15 per cent would disappear steadily over the next century (Feinstein, 1988: 388). An alternative was the demolition rates computed for Spain by Bonhome and Bustinza that I accepted up to 1940.[86] For the years 1940-1958 I derived them from existing sources (Nomenclators and Censuses of dwellings).[87] The resulting demolition annual rates were, 1861-1910, 0.21; 1911-40, 0.28; 1940s, 0.36; and 1950s, 0.26.

To sum up, the change in the quality-adjusted stock of dwellings includes the net increase in stock plus the replacement of demolished dwellings -that is, the increase in gross stock- to which a yearly 0.5 per cent quality improvement was applied. In order to distribute the inter-censal increase in the gross stock annually, available figures for the consumption of cement and timber were used for 1850-1944, while the annual number of new dwellings (mostly subsidized construction) was taken for 1944-1958.[88] To obtain yearly output figures repairments and maintenance expenses were added to the quality-adjusted increase in gross stock. Repairments and maintenance were assumed to represent 1 per cent of the current stock (which was obtained through log-linear interpolation between pairs of adjacent censal benchmarks). Finally, urban and rural construction indices were combined into a single index using their respective shares in the

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century, i.e., Tafunell (1989b); Gómez Mendoza (1986). Data on the stock of urban dwellings is available in Tafunell (1989a).

[85] The assumed annual increase in size and quality is similar to the one estimated by Cairncross (1953) for the U.K., and was also accepted by Lewis (1978).

[86] Cf. Bonhome and Bustinza (1968). The extent to which the results from each estimate are similar is provided by the percentage of houses built in 1850 that still survived a century later (under the assumption that the demolished houses are always the oldest):

	1950	1960
Bonhome and Bustinza method	64.5	60.1
Feinstein method	64.6	59.4

[87] Before 1860, the stock of dwellings was backcasted with the rate of population growth and a demolition yearly rate of 0.2 per cent was assumed.

[88] Input consumption was derived from Carreras (1983). A two-year moving average was computed to allow for stocks. Consumption of timber and cement was combined into a single index with 1958 input-output (TIOE58) weights. Evidence on new dwellings comes from *Anuario(s) Estadístico(s)*.

total value of dwellings.[89] A specific deflator was, in turn, built up that combined construction materials costs and mason wages with 1958 input-output weights (TIOE58).[90] Annual current value added for the residential and commercial construction industry was obtained by projecting the level of gross value added for 1958 backwards with the quantity and price indices.[91]

III.3.2 Non-residential Construction

III.3.2.1 *Railways*

Expenditure on investment and maintenance in railways at 1990 prices computed by Cucarella (1999) is the basis of my estimates. He relied on decadal averages of nominal expenditure on investment and maintenance in railways estimated by Gómez Mendoza (1991), that were distributed annually over 1850-1920 using the number of kilometers under construction, for investment, and those under exploitation, for maintenance, and that he completed for the late 1920's and early 1930's with his own estimates (Cucarella, 1999: 84-85). In addition, Government's and Spanish national railways company's (RENFE) investment and maintenance expenditures in railways estimates by Muñoz Rubio (1995) were employed from 1940 onwards. Cucarella (1999: 78-80) deflated his current value estimates with a wholesale price index. I converted Cucarella's constant price estimates into nominal values using his own deflator and, deflated the series again with a specific railway construction price index that combines the costs of railway materials and mason wages with 1958 input-output weights (TIOE58).[92]

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[89] The value of urban and rural dwellings (the cost of the average rural (urban) dwelling times its number) over the following periods, prior to 1860, 1861-1911, 1911-1940, and 1961-1960, was computed from data in Bonhome and Bustinza (1969) for dwellings built in these periods and still existing in 1965. The resulting shares for urban dwellings were 0.3448 (1850-1860), 0.5289 (1861-1910), 0.8623 (1911-1940), and 0.8663 (1941-1960).

[90] The residential construction deflator included construction materials representing 49 per cent (0.32, timber; 0.30, cement; 0.38, iron and steel) and mason wages, 51 per cent.

[91] The 1958 Input Output Table (TIOE58) provided the shares for residential and commercial (0.7756) that was used to derive each sector value added from official national accounts (CNE58).

[92] For 1936-1939 only the expenditure per kilometer of line by the major railway companies, Norte and MZA, on the nationalist side was available (no data are available on the republican side during the Spanish Civil War). Lacking line length and expenditure per kilometre of line on the whole of Spain, no attempt was made to compute total expenditure and I accepted expenditure per line kilometre in the Francoist side as a proxy for changes in railway construction during the war years, 1936-1939. The deflator for railways construction was obtained by allocating 65.6 per cent to materials costs (0.13, timber; 0.23, cement; 0.64, rails) and 34.4 per cent to mason wages.

III.3.2.2 *Roads*

Investment, repairs, and maintenance expenditures on roads at current prices are available since 1897 (Uriol, 1992). Nominal road expenditure was backcasted to 1850 with the rate of variation of public expenditure on roads (Comín, 1985b). The resulting yearly figures for 1850-1935 were adjusted to match the decennial estimates by Gómez Mendoza (1991). Finally, current expenditure estimates were deflated with a specific price index computed by combining materials costs and mason wages with 1958 input-output weights (TIOE58).[93]

III.3.2.3 *Hydraulic Infrastructure and Other Public Works*

Investment, maintenance, and repairs expenditures on hydraulic infrastructure and maritime and harbour expenditure by the central Government were deflated with a specific price index including construction materials and wages.[94]

Indices of non-residential construction were built up combining railway, and road construction, hydraulic infrastructure and other public works with their 1913, 1929, and 1958 shares in the sector's value added.[95] A compromise, single quantity index for the whole period 1850-1958 was built up as a variable weighted geometric average of each pair of adjacent benchmark's indices (as in the case of manufacturing).

It is worth mentioning that Alfonso Herranz-Loncán (2004) estimated output in infrastructure for 1860-1935 at a more disaggregated level than the one presented here. His results are coincidental with mine but show higher volatility, due to the fact that only investment is considered while maintenance is neglected (Figure 18). For this reason I have not incorporated Herranz-Loncán estimates here.

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[93] In the road construction deflator construction materials represented 55 per cent (0.69, cement; 0.31, iron) and mason wages, 45 per cent.

[94] Data on Government expenditure on hydraulic infrastructure are provided in Fundación BBV (1992) and public expenditure on maritime works and harbours in Comín (1985b). The deflator used was constructed from prices for public works materials and wages, weighted according to 1958 input-ouput table (TIOE58). Thus, 57.4 per cent was allocated to public works materials (0.08, timber; 0.24, iron; 0.68, cement) and 42.6 per cent, to mason wages.

[95] The 1958 input-output table (TIOE58) offers the shares of each non-resindential construction branch in its total value added provided by 1958 national accounts (CNE58). The shares for 1913 and 1929 were derived from the current value estimates described in the text. For 1936-1939, given the dearth of data data, an index was built up on the basis of railways construction and spliced with the main index using 1935 as the link year. Also an index including 1940 was constructed on reduced information as maritime and harbour expenditure was missing and spliced with the main index with 1941 as the link year.

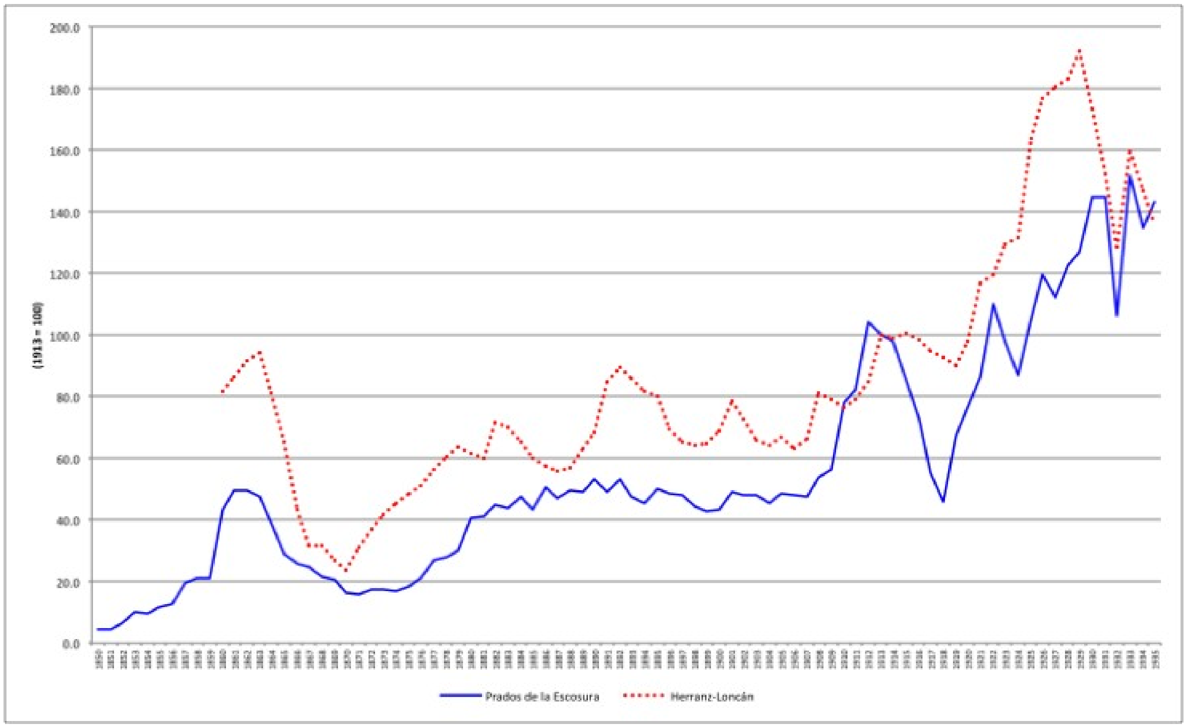

Figure 18. Non-residential Construction Volume Indices, 1850-1935: Alternative Estimates (1913=100)
Sources: Prados de la Escosura, see the text; Herranz-Loncán (2004).

Current value series for each branch of non-residential construction was obtained by linking the level of gross value added for 1958 to its Laspeyres quantity and price indices and, then, added up to represent total value added in non-residential construction. An implicit deflator was computed.

III.3.3 Value Added in Residential and Non-residential Construction

Residential and non-residential construction output was, then, combined into a single index for the construction industry with their 1913, 1929 and 1958 shares in the sector's value added, from which a spliced volume index was derived using a variable weighted geometric average.

Nominal gross value added for the entire construction industry was obtained by adding up residential and non-residential construction value added at current prices. An implicit (semi-Paasche) deflator was derived from current value (in index form) and the aggregate volume index.[96]

III.4 Services

Estimating value added in services represents the main obstacle in the construction of historical national accounts, especially in the case of those services for which no market prices exist, and also an unsurmountable problem in international comparisons.[97] In the present estimate the use of employment data has been avoided and output indicators used instead.[98] When the output of services is derived using labour input data, productivity cannot be estimated since by construction it is implicitly assumed that output per worker remains stagnant. Major subsectors considered here are transport and communications, trade (wholesale and retail), banking and insurance, ownership of dwellings, public administration, education and health, and other services -including restaurants, hotels and leisure, household services, and liberal professions. Several steps were taken to produce annual quantity and price indices for the different branches of the service sector.

III.4.1 *Transport and Communications*

Transportation and communication services include water (coastal and international), road, urban, air and rail transport plus postal, telegraph and telephone services.

For transportation by rail, merchandise and passenger output series are available for the period 1868-1958 and were backcasted to 1859 with the volume of merchandise and passengers transported.[99] A spliced index of total rail transport output was obtained with rates per passenger- and ton-kilometre for 1913, 1929 and 1958 as weights over 1859-

[96] The 1958 Input Output Table (TIOE58) provided the shares for residential and commercial (0.7756) and non-residential construction (0.2244) that were used to derive each sector value added from official national accounts (CNE58).

[97] See Maddison (1983) and Krantz (1994). Cf. Melvin (1995) for the evolution of the concept of services.

[98] The exception is household services.

[99] Actually, while merchandise output, measured in metric tons-kilometer, is available since 1868, passenger output, measured in passenger-kilometer, is only available for the two main railway companies, Norte and MZA, before 1913. I linked MZA and Norte's passenger output over the years 1867-1913 to total passenger output for 1913-1958. The sources are Gómez Mendoza (1989) and Muñoz Rubio (1995). For the Civil War (1936-39), the output series were interpolated with evidence on merchandise and passenger transported by Norte and MZA on the nationalist side, cf. Muñoz Rubio (1995), pp. 282 and 287.

1964, that was extrapolated back to 1850 with the rate of variation of railway tracks. Thus, 1913 weights were applied for the period 1868-1913, while variable weighted geometric averages of 1913 and 1929 (1929 and 1958) weighted indices were accepted for 1913-1929 (1929-1958). Prices, that is, average output per passenger-kilometer and ton-kilometer (in pesetas), were taken from Gómez Mendoza (1989) and Muñoz Rubio (1995). Value added at current prices in rail transport was obtained by linking the 1958 level (CNE58) to quantity and price indices (average prices per passenger- and ton-kilometer).

For maritime transport, coastal and international transport services were distinguished. For coastal transport, merchandise output (expressed in tons-kilometre), available since 1950, was projected backwards to 1857 with tons of merchandise transported, while only the number of passengers transported was available from 1928 onwards. An unweighted average of the quantity indices of passenger and merchandise coastal transport was computed for 1928-1958 that was, then, spliced with the merchandise index in order to cover the period 1857-1958.[100] International transport services for 1942-1958 were measured by the total value of passenger and merchandise freights received by Spanish ships and, then, deflated by their respective freight indices.[101] For 1850-1942, merchandise transport was computed by applying a freight factor to the total value of exports and imports carried under Spanish flag that was, then, deflated by a freight index.[102] An index for international sea transport was computed using 1958 passenger and merchandise freight rates as weights for 1942-1958 and, then, projected backwards with the merchandise index to 1850. Finally, value added for maritime transport

[100] The source for merchandise output since 1950 is Instituto de Estudios de Transportes y Comunicaciones (1984). Merchandise and passenger transported are provided in Frax (1981) and Gómez Mendoza (1989) for 1850-1950.

[101] Data from Estadística de fletes y seguros (1942-1956) and Ministerio de Hacienda, Dirección General de Aduanas (1957-1958) kindly supplied by Elena Martínez Ruíz.

[102] The freight factor series used -that is, the ratio of freight costs to total traded value- and the total value of Spanish international trade derive from section IV. The freight indices correspond to iron ore, for exports, and a weighted average of wheat and coal freights, for imports. The sources for freights are Coll and Sudrià (1987), Isserlis (1938), North (1965), and Prados de la Escosura (1984). The share of tonnage trasported under Spanish flag derives from Valdaliso (1991) for 1850-1935 and from Anuario(s) Estadístico(s), thereafter.

at current and constant prices was derived projecting value added for 1958 (CNE58) backwards with freight and quantity indices for coastal and international transport.[103]

For road transport, merchandise and passenger output are available since 1950 and were backward projected to 1940 with the number of tons and passenger transported.[104] A road transport output index was computed as an average of merchandise and passenger output for 1940-1958 and backward projected to 1850 with the road length that, to allow for its use, was weighted by the stock of motor vehicles over 1900-1940.[105] Value added at current prices in road transport was obtained by linking the 1958 level (CNE58) to the output index and a price index for gasoline.[106]

Urban transport was aproximated by the number of passengers transported by tramways, trolley buses, buses, and metro from 1901 onwards (Gómez Mendoza 1989). Value added at current prices was reached through backward projection of the 1958 level (CNE58) with the rates of variation of the sector's revenues.[107]

For air transport, passenger output is available since 1929 and merchandise output from 1950 onwards, that was projected backwards to 1930 with the rate of variation of total merchandise transported; both series were combined into a single quantity index using with equal weights.[108] Value added was computed annually by backcasting the level for 1958 with the output index and a price index for gasoline.[109]

Finally, road, urban, water, air and rail indices weighted by their contributions to transport gross value added in 1913, 1929 and 1958 (CNE58) provided an aggregate index

[103] Coastal freights per ton were computed for 1932-1958 from Valdaliso (1997). For 1857-1932, it was assumed that coastal freights evolved as freights in international trade (on freights see section IV). Shares of coastal (0.6) and international transportation (0.4) in 1958 value added were derived using freight rates and tons and passenger trasported.

[104] Road output (both passenger and merchandise) is provided in Muñoz Rubio (1995) from 1950 onwards. Tons and passenger transported for 1940-1950 derive from Anuario(s) Estadístico(s).

[105] The stock of motor vehicles is provided in López Carrillo (1998). For the road length, the sources are Gómez Mendoza (1982, 1989) and López Carrillo (1998).

[106] The price of gasoline is available since 1913 in Anuario(s) Estadístico(s) and was backward projected to 1901 with the price of petroleum in Carreras (1989). For the late nineteenth century it was assumed that road transport prices fluctuate along rail transport prices.

[107] Actually, CNE58 only provides value added for "other transport" that was distributed between urban and air transport using the 1958 input-output table (TIOE58).

[108] The sources are Gómez Mendoza (1989) and Anuario(s) Estadístico(s).

[109] This price index is the same used in the case of road transportation.

for transport services.[110] A spliced quantity index was constructed for 1850-1958 as a variable weighted geometric average of each pair of adjacent benchmark's indices.

Annual value added in transport services (at current prices) was reached by adding up rail, water, road, air and urban transport value added derived through linking 1958 value added levels (CNE58) to their quantity and price indices. An implicit deflator resulted of dividing current value added (in index form) by the aggregate volume index.

For communication services, postal (number of letters and parcels sent), telegraph (number of telegrams) and telephone (calls from 1924 onwards, backcasted with lines in service to 1897) indices were merged into an aggregate index using their 1913, 1929 and 1958 revenues as weights that were, then, spliced into a single index using variable weighted geometric average.[111] Current value of communications services were derived by linking the 1958 value added level (CNE58) to each subsector's yearly revenues.[112] An implicit deflator resulted from current value added (in index form) and the quantity index.

III.4.2 *Wholesale and Retail Trade*

Due to dearth of data on distribution, it was assumed that trade output was a linear function of physical output, and a quantity index was derived by combining, with 1958 weights, agricultural (including fishing), mining and manufacturing output plus imports of goods, from which a two-year moving average was computed to allow for inventories.[113]

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[110] Weights were 0.44 for road transport; 0.1148, urban; 0.16, water; 0.0266, air; and 0.2586, rail, derived from CNE58 and TIOE58. For years in which information was incomplete, indices were built on partial evidence and spliced with the main index. That was the case for 1936-1939, when only air, road and sea transport indices were available, and for 1850-1856 when just rail and sea transport indices existed.

[111] Only figures for mail services go back to 1850; telegraph services are recorded for 1855 and, then, annually from 1860, and telephone services from 1886 (number of telephones, but calls only from 1924). The sources are Calvo (1998), Gómez Mendoza (1989) and Mitchell (1992). 1958 weights were 0.6198, telephone; 0.2955, post; 0.0847, telegraph. The spliced index was constructed as in the case of trasportation.

[112] Revenues for telegraph services are only available from 1896 (Gómez Mendoza, 1989) onwards and for telephone services since 1925 (kindly provided by Nelson Alvarez).

[113] This short-cut has been used before by Lewis (1978), van der Eng (1992), Cortés Conde (1994, 1997), Batista et al. (1997), Smits et al. (2000) in historical estimates for Britain, Indonesia, Argentina, Portugal and the Netherlands, respectively. Similar methods were applied to Denmark, Sweden and Germany (cf. Krantz, 1994). In the Spanish case, this procedure was accepted in both contemporary and historical estimates (Vandellòs, 1925; Schwartz, 1977). 1958 shares in gross value added (CNE58), except for imports where total value was accepted (see next section), were the weights used for computing the trading quantity index. The shares used were: agriculture, 0.3953; manufacturing, 0.4575; mining, 0.0339; imports, 0.1133. Krantz (1994:26) assertion that "some form of association exists between commodity production and trade but a

Value added at current prices was obtained by linking the 1958 level to the quantity index and a price index (computed on the basis of the same trade components and 1958 shares).

III.4.3 *Banking and Insurance*

Value added at current prices was computed by splicing 1958 value added for banking and insurance services (CNE58) with the joint index of banking deposits and insurance premia. Deposits in commercial and savings banks and the value of insurance premia, expressed in index form (with 1958 =1) were weighted according to their shares in the 1958 input-output table's sectoral value added (TIOE58) to derive an aggregate nominal index. Value added at current prices was deflated with a wholesale price index.[114]

III.4.4 *Ownership of Dwellings*

It was assumed to evolve as the quality-adjusted stock of dwellings.[115] Value added at current prices was derived splicing the 1958 level (CNE58) to the quantity index and a rent of dwellings deflator.[116]

III.4.5 *Public Administration*

Services output for public administration was measured by wages and salaries paid by the central government, which were deflated by a cost of living index.[117] Value added

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priori a total correlation cannot be expected" led me to prefer a two-year moving average alternative of the form, $Y_t = 0.5\, X_{t-1} + 0.5\, X_t$, where Y represents distribution, and X the combination of physical output plus imports in year t.

[114] 1958 input-output table shares (TIOE58) were 0.7946 for banking and 0.2054 for insurance services. Data for insurance premia are only available from 1909 onwards, and evidence on banking deposits were accepted as a good proxy for banking and financial services beforehand. When information was incomplete, as it was the case during the Civil War, indices were built on partial evidence and spliced with the main index. The sources for banking deposits are Tortella (1974, 1985), for 1856-1899, and Martín Aceña (1985, 1988), from 1900 onwards. Insurance data derives from Frax and Matilla (1996) for 1909-1937 and *Anuario(s) Estadístico(s)*, thereafter.

[115] Estimates at census dates were log-linearly interpolated to derive annual figures (see section on construction industry above).

[116] The average price of urban dwellings that times the mortgage interest rate offered by Banco Hipotecario (kindly supplied by Juan Carmona) provides the implicit rent of dwellings for 1864-65 and 1904-1934, while Ojeda (1988) presents a deflator for dwelling rents for 1936, 1939-1958. The rent of dwellings deflator was interpolated with the rate of variation of the construction industry deflator.

[117] No allowance for government's rents (and depreciation) from buildings was made. Wages and salaries paid by the government are taken from Comín (1985b). The cost of living index derives from Ojeda (1988) for 1909-58 and it was backcasted to 1850 with Reher and Ballesteros (1993) price index. This option has

at current prices was obtained by backcasting the 1958 benchmark level with the rate of variation of wages and salaries paid by the central government.

III.4.6 *Education and Health*

For education services, an index of schooling weighted by deflated Government expenditure on education, to allow for quality changes, was used.[118] For health, the number of hospital patients was combined with deflated public expenditure on health in order to incorporate quality improvements.[119] Value added in education and health was obtained by projecting value added in 1958 with their quantity indices and a wholesale price index.

III.4.7 *Other Services*

In the cases of household services and liberal professions, the usual assumption that output evolved as the labour force employed in each sector was accepted, namely, that no productivity growth occurred, and yearly figures were obtained from log-linearly interpolating census data.[120] Value added was reached by linking the 1958 level to the quantity index and a wage index (household services) or the wholesale price index (liberal professions). Finally, for hotel, restaurant and leisure services were crudely approximated combining indices of room occupancy and leisure.[121] Value added was derived by splicing 1958 level with the quantity index and the cost of living.

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been prefered to the alternative of deflating government's wages and salaries by a wages index. The latter would imply that no labour productivity increase takes place at all, since total wages and salaries paid by the government, that is, employment numbers times wages, are deflated by a wage index (Krantz, 1994). This only holds, of course, under the assumption that wages in the public sector and in the economy as a whole evolve the same. In the favoured alternative, if wages and salaries rise faster than prices, a productivity increase will be attributed to government (Heston, 1994: 46).

[118] A geometric average was computed with indices of education enrolment (primary, secondary, and tertiary education log-linearly interpolated) from Almarcha, 1975; Anuario(s) Estadístico(s); Núñez, 1993; Mitchell, 1992) and Government expenditure on education (Comín (1985b) deflated by a wholesale price index (Sardá, 1948; Ojeda, 1988). An alternative measures using Núñez (2005) data on education enrolment hardly alters the overall index so I have kept the initial estimates.

[119] A geometric mean of the number of patients and public expenditure on health deflated with a wholesale price index, expressed in index form, was computed. The sources are Almarcha (1975) and Anuario(s) Estadístico(s). Before 1909, it was assumed that health services evolved as education services.

[120] The sources are Spain's population census. Alternatively, it could have been assumed steady labour productivity improvement over time as Lewis (1978: 264) did for late 19th century Britain.

[121] Evidence on room occupancy was only available since 1941. Over 1901-1941, the index of leisure was employed only. This leisure index was an average (with TIOE58 weights) of theatre and cinema (from 1940

III.4.8 Value Added in Services

Next, index numbers for the different branches of services were merged into an aggregate index, with 1913, 1929, and 1958 weights, which correspond to their contributions to total gross value added in services (Table 11). A compromise, single index was computed through a variable weighted geometric average, as in the cases of agriculture and industry.

Aggregate gross value added at current prices was computed by adding up all services' value added. An implicit deflator was obtained from current value (in index form) and the aggregate quantity index.

Table 11
Breakdown of Gross Value Added in Services, 1913-1958 (%)

	1913	1929	1958
Transport and Communications	18.2	23.3	16.0
Trade, Wholesale and Retail	31.7	29.6	27.9
Banking and Insurance	2.3	4.6	8.6
Property of Dwellings	7.7	6.9	7.6
Public Administration	13.8	12.1	12.6
Education	2.6	2.4	2.9
Health	0.5	0.8	2.4
Restaurants, Hotels	10.6	7.0	5.6
Domestic Service	3.0	3.0	4.2
Liberal Professions	9.5	10.2	12.2

Sources: 1958, CNE58; 1913-1929, see text.

III.5 Total Gross Value Added and GDP at Market Prices

A Real Gross Value Added index was constructed for 1850-1958 by weighting output volume indices for each major branch of economic activity (agriculture, industry, construction, and services) with their shares in total gross value added for 1958.[122] Nominal Gross Value Added was obtained by adding up GVA at current prices for each

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onwards) and bullfighting (since 1901) attendance. For the late nineteenth century, it was assumed that the index fluctuates along the retail and wholesale trade index.

[122] Alternatively, independent indices have been built for 1850-1913, 1913-1929, and 1929-1958 and, then, spliced using variable weighted geometric averages of the three indices. Differences between the chain index and the single 1958-weighted index are practically negligible due to the fact that chain indices have been previously computed for each main sector of economic activity. Therefore, I have preferred the aggregate GVA series that results from single 1958 weighting, so additivity of the aggregate index's components is maintained throughout 1850-1958. In the alternative approach, additivity would only hold for each period, but not for the aggregate, single GVA index.

major branch of economic activity. GDP at market prices resulted from adding indirect taxes less subsidies to total GVA. An implicit Gross Value Added deflator was derived from nominal and real values expressed in index form (1958=1). Real GDP at market prices was derived with the GVA deflator.

IV. MEASURING GDP, 1850-1958: DEMAND SIDE.

Measuring aggregate economic activity through the expenditure side represents adding up all final products or sales to final demand. Ideally, each expenditure component should be computed with actual data from households, firms, and public administration. Unfortunately, lack of direct evidence renders such a task impossible and the so-called commodity flows approach provides a second-best alternative.[123] This method uses output figures for agriculture and industry that are adjusted to include imports and to exclude exports in order to derive estimates of consumption and investment. An implication is that the GDP output and expenditure estimates are not independent from each other.

I will succintly describe the procedures and sources used to derive estimates for private and public consumption of goods and services, domestic investment, and net exports of goods and services. In all cases, except for net exports of goods and services, the same method employed in the output approach to obtain GDP levels will be followed. That is, in order to compute annual nominal GDP the level for each expenditure component in 1958 was backcasted with the yearly variations of Laspeyres quantity and Paasche price indices and the resulting series added up. For investment, private consumption and gross domestic expenditure quantity indices at 1913, 1929 and 1958 relative prices were constructed and, then, a single index for each demand component was obtained by splicing the three volume indices using a variable weighted geometric average. A volume index of real GDP results from adding up its component indices with weights from 1958 national accounts.

A word of warning is necessary. GDP estimates from the expenditure and output sides are not coincidental. Since it is widely accepted that measurement errors tend to be smaller when the production approach is used, I have chosen GDP computed from output side as the ‘control final’, and private consumption, the largest expenditure component,

[123] The commodity flows approach is common in present time developing countries (Heston, 1994) and in historical national accounts. Cf. the pioneering work by Jefferys and Walters (1955) on the U.K., extended by Deane (1968) and Feinstein (1972), and more recently, the research by Carreras (1985) on Spain, Vitali (1992) and Baffigi (2013) on Italy, and Smits, Horlings and van Zanden (2000) on the Netherlands.

was adjusted so GDP from the demand side conforms to GDP derived from the supply side.

IV.1 Consumption of Goods and Services

Consumption represents the part of final output used up for its own sake. Current expenditure on goods and services by consumers (households and non-profit organizations) and by public administration (central and local government) can be distinguished. While tastes, incomes, and relative prices will determine household consumption, political motives are behind public consumption (Beckerman, 1976).

IV.1.1 Private Consumption

To derive yearly estimates of private consumption quantity and price indices were constructed for its major components: foodstuffs, beverages, and tobacco; clothing; current housing expenses, including the rent of dwellings, heating and lighting, plus current expenses on household maintenance; household consumption of durable goods; hygiene and personal care; transport and communications; leisure; and other services including education and financial services. Most of the available evidence for private consumption's components comes from output estimates to which net imports were added. I will discuss briefly the construction of indices for each consumption component. Paasche price indices were computed for each private consumption component using, unless otherwise stated, the same method and evidence described for agriculture and industry in the previous section.[124]

IV.1.1.1 *Foodstuffs, Beverages, and Tobacco*

This was still the main component of private consumption by 1958, and includes bread and cereals, meat, fish, milk, cheese and eggs, oil and fat, potatoes, legumes, vegetables and fruit, coffee and cocoa, and sugar, plus beverages (beer, wine, brandy) and tobacco. Evidence on quantities and prices gathered to compute output in agriculture and in food industry in the previous section together with net imports has been used to

[124] Unfortunatelly, prices are, unless otherwise stated, wholesale prices and not retail prices, as national accounts convention establishes.

produce constant and current price series of foodstuffs consumption.[125] Major consumption groups in national accounts (CNE58) were dissagregated into its individual components using the input-output table for 1958 (TIOE58). Consumption, in most cases, was estimated from final output figures, that is, total output les seed and animal feed, to which net imports were added.[126] Wheat and rice milling output were accepted as indicators for bread and cereals. Evidence on meat consumption in capital cities was used to cross check estimates of total consumption on the basis of meat output plus net imports.[127] Fish captures plus net imports were used for fish consumption. For milk, cheese and eggs, output figures were used. For oil and fat, evidence on the proportion of human consumption of olive oil and its derivatives was employed.[128] Data on final output less net exports were used for potatoes, legumes, vegetables, and fruits. The consumption of sugar (both cane and beet) was obtained by adding up output and net imports.[129] Imports were accepted for the consumption of tobacco, chocolate (cocoa), and coffee.[130] Quantity indices were computed with 1870, 1890, 1913, 1929 and 1958 benchmarks and, then, spliced into a single index using variable weighted geometric averages in which the larger weight corresponds to the closer benchmark (see expression 12). Individual price series were taken from the section on output. A Paasche price index was derived from current values (in index form) and the chain Laspeyres quantity index.[131]

IV.1.1.2 ***Clothing and Other Personal Articles***

The output and price series for clothing and shoemaking were accepted and aggregated with weights from 1958 national accounts (CNE58). For clothing a spliced

[125] Net imports, that is, retained imports less domestic exports, were taken from Estadística(s) del comercio exterior. Gallego and Pinilla (1996) provide agricultural trade figures at 1910 prices for main commodity groups in the years 1850-1935, and I have drawn on their figures whenever necessary.
[126] The description of the construction of output figures is presented in section III of the essay.
[127] Gómez Mendoza (1995) provides estimates of meat consumption for 1900-1933. Anuario(s) Estadístico(s) provide consumption figures from 1921 onwards.
[128] García Barbancho (1960: 299).
[129] Martín Rodríguez (1995) supplies quinquennial average estimates of sugar consumption from 1855 to 1904. I constructed annual consumption estimates for the nineteenth century on the basis of Martín Rodríguez estimates, imports of sugar, and data on domestic production.
[130] Alonso Alvarez (1993, 1995) provides current values of legal consumption of tobacco. Anuario(s) Estadístico(s) present evidence for 1901-1958. Estimates of smuggling through Gibraltar and Portugal for 1850-1913 are provided in Prados de la Escosura (1984).
[131] Incidentally, the Paasche deflator for foodstuffs, beverages, and tobacco matches closely Maluquer de Motes (2006) Laspeyres index of foodstuffs.

index for the whole period under consideration was constructed using 1913, 1929, and 1958 weights.

IV.1.1.3 ***Housing Current Expenses***

Under this label, dwelling rents, heating and lighting, and maintenance expenses are included. For rents paid for dwellings and for those imputed when occupied by their owners, quantities and prices from the output series were accepted. For heating and lighting, figures on domestic consumption of electricity and gas are provided by Anuario(s) Estadístico(s) since 1901 and 1930, respectively. I have computed figures for the earlier years by extrapolating consumption levels with the rate of variation for electricity and gas total output. Domestic consumption of coal was also added, but lack of direct evidence led me to assume that household consumption of coal evolved as total coal consumption. Prices were taken from the output estimates. Household maintenance expenses were computed by adding up domestic services and the consumption of non-durable goods with 1958 input output weights.[132] Output and price estimates for domestic services were employed. Non-durable goods consumption was estimated through backward projection of 1958 levels, taken from the input-output table (TIOE58), with the rates of variation of its output, under the arbitrary assumption that household consumption represented a stable proportion of its production.[133]

IV.1.1.4 ***Household Consumption of Durable Goods***

Household consumption of durables was approximated with furniture consumption. 1958 consumption levels were backcasted with rates of variation for timber and furniture output under the arbitrary assumption that the proportion allocated to private consumption was constant over time. Price indices for output were accepted.

IV.1.1.5 ***Hygiene and Personal Care***

The output and price series for health services were used to approximate the expenses on personal care.

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[132] Weights were 0.5518 for domestic services and 0.4482 for non-durables.

[133] Household consumption of non-durable goods included chemicals (0.6748), construction materials (0.2225), and rubber goods (0.1027). Weights are taken from TIOE58. Prices from output estimates were employed.

IV.1.1.6 *Transport and Communications*

Expenses on transport services included purchases of automobiles and transport and communications expenses. 1958 levels were projected backwards with the number of registered automobiles and the rate of variation in the number of registered cars and in transport and communications output, respectively.[134]

Leisure

The corresponding series for the output of restaurants, hotels and leisure services were accepted, while the paper industry's output was used to approximate books and periodicals consumption.[135] Weights were taken fron the 1958 input-output weights (TIOE58).

IV.1.1.7 *Education, Financial and Other Services*

The output of education services has been adopted for education and research consumption. The consumption of financial services was also approximated through its output. Liberal professions employment represented the consumption of other services. The price index for "other household consumption services" was used back to 1939 and spliced with the cost of living index back to 1850 (Ojeda, 1988).

Nominal private expenditure on goods and services was derived by projecting the current value of each of its components in 1958 (CNE58) backwards with their quantity and price indices (expressed a 1858 = 100) and, then, adding them up.

An aggregate volume index of real private consumption was, then, computed. Quantity indices were, firstly, built up on the basis of volume indices for private consumption components at 1913, 1929, and 1958 relative prices and, later, spliced into a single index for 1850-1958 resulted from splicing all three segments using a variable weighted geometric average of quantity indices at 1913 and 1929 prices for 1913-1929, and at 1929 and 1958 prices for 1929-1958. An implicit deflator was calculated with current and constant price estimates. The resulting Paasche deflator of private

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[134] An alternative measure would be tax revenues on land trasportation, petroleum and gasoline, and on post, telegraph, and telephone services. However, changes in the tax rate make impossible to employ available evidence without a previous adjustment of tax returns for changes in fiscal pressure.

[135] Prices used were the cost of living index for restaurants, hotels and entertainment, and the paper industry deflator. TIOE58 weights were 0.2102, entertainment (films and theatres performances, bullfights and radio broadcasting); 0.6291, hotels and restaurants; 0.1607, books and newspapers.

consumption and Maluquer de Motes (2006) Laspeyres consumer price index are highly coincidental, somehow an unexpected result due to their different weighting (Figure 19).

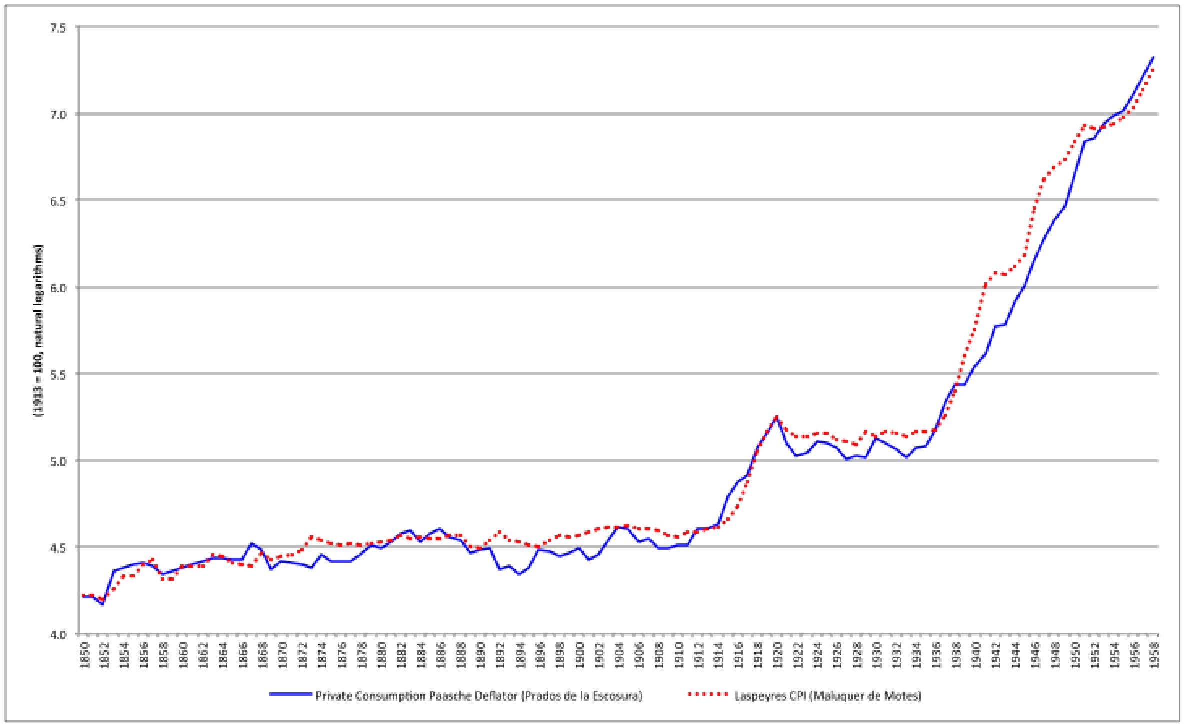

Figure 19. Private Consumption Paasche Deflator and Laspeyres Consumer Price Index, 1850-1958 (1913 = 100) (logs)
Sources: Private Consumption Deflator, see the text; CPI, Maluquer de Motes (2006).

IV.1.2 Public Consumption

Wages and salaries and purchases of goods and services by the central Government are both provided for the entire period 1850-1958 by Francisco Comín (1985b), while no data on rents imputed to public buildings was available. Annual figures for local government consumption are only available from 1927 onwards, but scattered evidence exists for 1857-1858, 1861-1863, 1882 and 1924.[136] I have re-scaled central government figures with their ratios to local and central government consumption for these years.[137] Yearly public consumption at current prices was derived through backward projection of the level for 1958 (CNE58) with the annual rate of variation of central and local

[136] I am indebted to Francisco Comín for kindly supplying me with his unpublished figures.
[137] Fortunately, the ratio ranges from 0.63 to 0.70, in a diminishing order. I have log-linearly interpolated the ratio and I used it to re-scaling central government's expenditure correspondingly. No data exists for the Civil War years (1936-39). I assumed public consumption was at its peak during those years and adopted its ratio to private consumption during World War II years.

government consumption estimates. Nominal public consumption was deflated with the cost of living, a wholesale price index, and the rent of dwellings deflator weighted with the shares of salaries, goods purchased, and rents inputed to public buildings in 1958.[138]

IV.2 Gross Domestic Capital Formation

The current output of goods and services devoted to increasing the nation's stock of capital and, hence, to raising the future potential income flow, is called domestic investment or capital formation. Fixed capital formation and changes in inventories are the components of domestic investment.

IV.2.1 Gross Domestic Fixed Capital Formation

Gross fixed capital formation can be defined as capital expenditure on domestic reproducible fixed assets (including both new investment and replacement). More frequently it is described as the value of purchases and construction of fixed assets by residents firms and government, and all durable production goods lasting more than a year are included. In addition, major alterations of existing assets are considered capital formation and this includes all of those affecting buildings and construction. Inventories, in turn, refer to raw materials, work in progress, and stored finished goods.

Gross domestic fixed capital formation was classified in the OECD national accounts system according to three criteria, products, branches of activity, and institutions (CNE58). More detailed breakdown is presented in the contemporary input-output table for 1958 (TIOE58). Given data constraints, the products criteria will be followed to compute historical capital formation in pre-1958 Spain. As for consumption, the way of constructing current and constant price series for gross domestic capital formation was to start from the 1958 benchmark level and to extrapolate each of its individual components back to 1850 with quantity and price indices.[139]

Two alternative ways are used in capital formation estimates, the expenditure and the commodity flows approaches. The expenditure approach establishes the actual investment by firms or by the government, and it is the most rigurous and data

[138] Weights come from TIOE58 and they are 0.6791, cost of living; 0.2995, wholesale price index; 0.0214, the rent of dwellings deflator.

[139] This is a similar method to the one followed by Feinstein (1972: 184) for late 19th and early 20th century Britain.

demanding one. Its large data requirements, however, makes it also the less frequent procedure in historical accounts and in present-day developing countries national accounts. In the present historical estimates, this expenditure approach was exceptionally used for private investment (only for telephone communications). The alternative commodity flows method reaches investment figures by adding net imports to domestic output of capital goods. In other words, the commodity flows approach is not independent from the output method, but it is the only feasible way to compute investment in historical cases, aside from the most recent period or from those countries with exceptionally good records (i.e., the U.K. and the U.S.A.).

An additional difficulty comes from the lack of evidence on prices for capital goods. With the exception of unit value data from commercial statistics from trading partners (UK, France, Germany, the U.S.) and ocassional evidence for bulky and expensive capital goods (locomotives, ships), deflators had to be constructed on the basis of input prices, wages, and raw materials, combined with input-output weights (TIOE58). This means that usually no allowances are made for productivity change in capital goods' industries.[140]

In the classification by products, fixed capital formation is distributed into dwellings, other buildings, other constructions and works, transportation material and other materials (machinery and equipment). In the following paragraphs a brief description of the sources and procedures used to construct quantity and price indices for the main categories of fixed capital formation and for variations in stocks are provided.

IV.2.1.1 *Dwellings and Other Buildings*

Data restrictions prevent to consider dwellings and other buildings separately.[141] Capital formation in dwellings and other buildings are represented by the output index of residential and commercial construction, excluding repairs and maintenance expenses. The output deflator was used.

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[140] Cf. Feinstein (1988: 262).
[141] See construction industry in section III.

IV.2.1.2 *Other Constructions and Works*

Roads, streets, sanitation, railways, docks, tunnels, bridges, dams, harbours and airports, drainage, irrigation and land improvement, electric instalations, telegraph and telephone lines, are all included in this category.

For capital formation in railway and road construction, hydraulic infrastructure and other works (maritime and harbours), output (quantity and price) indices have been accepted.[142]

Land improvement was approximated, in addition to central government investment on irrigation and drainage (already included under hydraulic infrastructure), through fertilizer consumption and afforestation (after 1900).[143] Price indices were built up on the basis of input costs.[144]

Capital formation in gas and mining was computed under the arbitrary assumption that the capital-output ratio was stable over time.[145] First differences (excluding negative values) in the output series provide, hence, new capital formation to which scrapping is added to obtain gross investment figures.[146] Scrapping is computed assuming an average asset life of 50 years.[147] When evidence on scrapping, that is, new capital formation fifty years back in time, was not available I assumed it was proportional to fixed capital formation. A price index was computed with input prices.[148]

[142] For railway and road construction the use of output as investment constitutes a wide definition of capital formation that includes maintenance and hence it implies a short life of assets. See the section on non-residential construction industry.
[143] The sources for fertilizer consumption are Gallego (1986), Barciela (1989), and Estadística(s) del comercio exterior (see footnote 56 for details). For afforestation the sources are GEHR (1989) and Barciela (1989).
[144] For land improvements deflator, wages were allocated 0.5 and material input prices 0.5 (0.25 for construction materials and 0.25 for fertilizers). For afforestation, material input prices were approximated with the agricultural deflator. Weights were computed from the 1958 input-output table (TIOE58).
[145] I follow here Feinstein (1988: 281-285, 303).
[146] The sources for gas and mining output are provided in the section on the output approach.
[147] Unfortunately, it was not possible to distinguish between buildings and work, on the one hand, and plant, machinery and equipment, on the other, that do have different asset lives (60 and 30 years, respectively, in the case of Britain, according to Feinstein (1988)). Given the longer life of assets in developing countries I assumed a 50 year average for both buildings and plants and machinery. As a consequence of this decision, capital formation in other construction and works is overexaggerated, as it also includes plant and machinery in gas and mining. However, such an upward bias is small given the size of capital formation in mining and gas.
[148] Weights taken from TIOE58 were 0.49, construction materials and 0.51, mason wages.

Capital formation on electricity structures was assumed to represent 15 per cent of total capital expenditure on electricity supply and the level for 1958 was projected backwards with the rate of variation in installed capacity (kilowatts) to 1890, to represent new investment, while scrapping was estimated assuming a 60 years average life.[149] The deflator was constructed with input prices for construction costs (0.8) and costs of plant and machinery (0.2).[150]

For communications works, private investment in telephone buildings and works was assumed to represent 15 per cent of total investment outlays over 1925-1958.[151] A deflator computed with construction materials and wages, combined with 1958 input-output weights, was used to derive constant price estimates.[152] For the years 1903-1924, real investment was extrapolated backwards with an index of investment. On the basis of the number of telephone offices, available since 1902, and assuming an average life above 60 years, real investment was computed as first differences from which a three-year moving average was accepted as the investment index.[153]

Once quantity and price indices were built up for each major component of capital formation on "other constructions and works", current price series were obtained by projecting 1958 levels (derived from CNE58 and TIOE58) backwards to 1850 with quantity and price indices that were, then, added up into a single series.[154] Quantity indices for

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[149] The 15 per cent share of total investment outlays and 60 years average life are taken from Feinstein (1988: 305), for the case of Britain. The value of capital expenditure in electricity supply comes from Banco Central (1961). Installed electric power is available since 1901 in Reseña Estadística (1952) and Anuario(s) Estadístico(s). Given its high correlation with electricity output (0.95 over 1901-1913), the installed capacity was backcasted with electricity output to 1890. For electricity output, see Carreras (1983, 1989).

[150] Cf. Feinstein (1988). Construction costs include wages (0.51) and construction materials (0.49). In turn, plant and machinery include steel (0.44) and wages (0.56).

[151] Capital expenditure by Telefónica, at current prices, for 1925-1958 was kindly supplied to me by Nelson Álvarez. The number of telephone offices is available since 1902 and, assuming a life average above 60 years (Feinstein (1988) assumes 100 years), investment can be computed as first differences. A three-year average (Yt=(Xt-2+Xt-1+Xt)/3) was estimated to smoothing the investment series.

[152] TIOE58 weights are 0.49, construction materials; 0.51, mason wages.

[153] A three-year moving average of the form, Yt=(Xt-2+Xt-1+Xt)/3 was used to smooth the series. Gómez Mendoza (1989) provides data on telephone centres. It should be bear in mind that Feinstein (1988) assumed a hundred years average life, but 60 years is enough to make my computational procedure acceptable as the period under consideration (1903-1958) is shorter and, hence, no scrapping has to be taken into account.

[154] The level of capital formation on other constructions and works for 1958 provided in CNE58 was distributed among its components using TIOE58.

total investment on “other constructions and works” were, then, constructed on the basis of its components’ indices with 1913, 1929 and 1958 weights, and a single index was derived through variable weighted geometric mean. The comparison between my estimates and those obtained by Herranz-Loncán shows a substantial degree of coincidence, although Herranz-Loncán series exhibits higher volatility (Figure 20). An implicit deflator was derived from current and constant price indices.

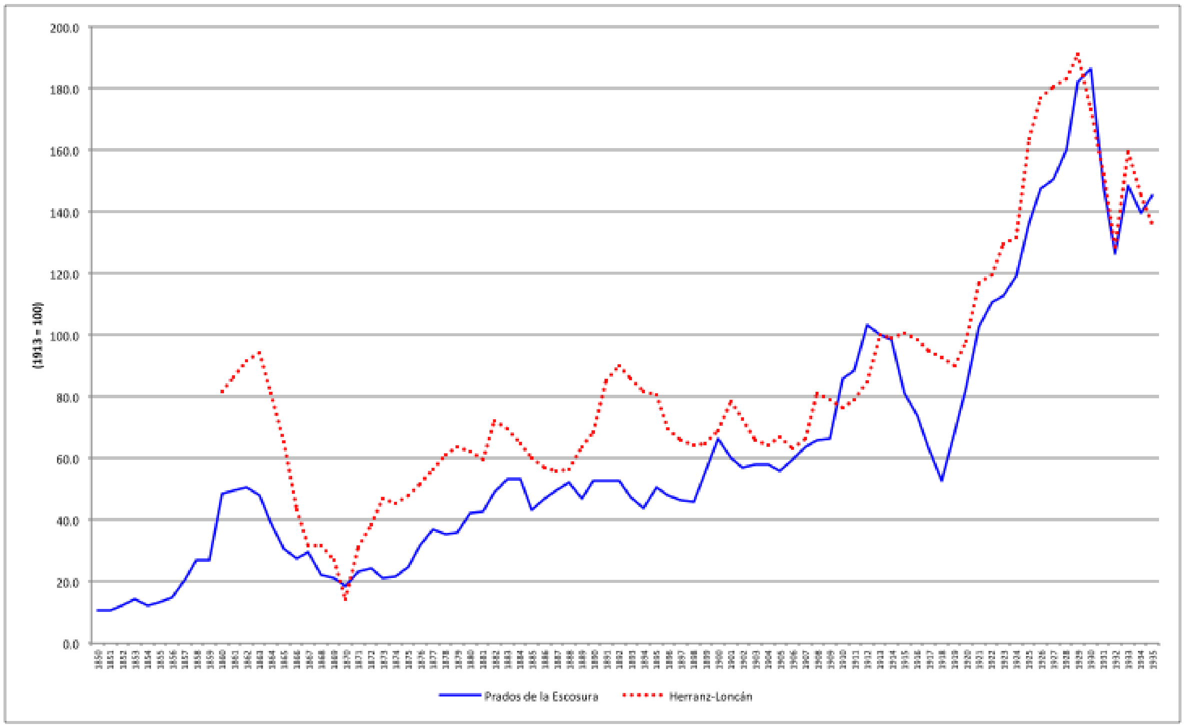

Figure 20. Gross Investment in Non-residential Construction Volume Indices, 1850-1935: Alternative Estimates (1913 = 100)
Sources: Prados de la Escosura, see the text; Herranz-Loncán (2004).

IV.2.1.3 *Transportation Material*

Under this concept all expenses on ships, vans, commercial vehicles, vehicles for public transport, airplanes, and rolling stock for railways and tramways, are included. Purchases of transport vehicles for private use (i.e., automobiles) are not considered as investment but as private consumption. Given the dearth of reliable data, only capital formation in railway rolling stock, ships and road vehicles will be considered here.

As for capital formation in railway rolling stock, new investment was derived as first differences from the stock of locomotives, cars and wagons to which scrapping obtained by assuming an average life for each type of asset was added.[155] Quality adjustments were introduced to allow for the locomotives' increasing power.[156] Quantity indices of investment in locomotives, cars and wagons were computed at 1913, 1929 and 1958 prices and, then, a single index was derived as a variable weighted geometric average. Current price estimates up to 1940 were obtained with quantities (unadjusted for quality) and available prices for locomotives, cars and wagons.[157] After 1940, data on current capital expenditure, available for Spanish state company, RENFE, was deflated with a price index constructed with input costs.[158] An implicit deflator was obtained from current values and the quality-adjusted quantity index.

The estimates of capital formation in merchant shipping include all sailing and steam ships.[159] No evidence on capital expenditure on shipping exists but yearly additions to tonnage can be computed through domestic production and net imports available from 1850 onwards.[160] A quantity index for investment has been obtained by adding net imports to domestic output.[161] A quality adjustment constructed for Britain, adapted to

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[155] Evidence on roling stock comes from Gómez Mendoza (1985b, 1989) and Muñoz Rubio (1995). No negative first differences were accepted. Average life of locomotives was estimated in 50 years while for cars and wagons 40 years was assumed, based on evidence presented in Cordero and Menéndez (1978: 298-299). Feinstein (1988: 313) accepted shorter lives for rolling stock in Britain (30 years). For 1850-1860, rolling stock deflated imports from Britain were used to project 1861 investment levels backwards to 1850.

[156] Cf. Average power of locomotives (steam, electric and diesel engines) was used to construct a quality index. Evidence is provided in Cordero and Menéndez (1978: 292-293) and Muñoz Rubio (1995: 306).

[157] The reason to excluding quality-adjusted quantities is that improvements in quality are already incorporated in locomotive prices. Prices for 1900-1935 are presented in Gómez Mendoza (1985b). Prices were backcasted to 1877 with a deflator constructed on the basis of input prices, weighted according to Gómez Mendoza's estimates and, again back to 1850, with unit values from imports of British rolling stock. Unit values for rolling stock imports from Britain were obtained from the U.K. Annual Statements of Trade and Navigation. The weights used are locomotives, 0.55, engineering wages; 0.45, iron; for cars, 0.35 wages; 0.41, iron; 0.27, wood; and, for wagons, 0.4 wages; 0.48, iron; 0.12, wood.

[158] Muñoz Rubio (1995) provides RENFE investment expenditure at current prices. The inputs and their weights are wages (0.5), steel (0.4) and wood (0.1). Weights come from TIOE58.

[159] Warships are not considered here and they are included under current public consumption expenditure, following the national accounts' convention.

[160] An exception is Valdaliso (1991) for Vizcaya.

[161] The years covered are 1850-1936 and 1940-1958. It was arbitrarily assumed that no investment took place over 1937-1939 (it should be remember that warships did not represent capital formation but public consumption). The sources are Valdaliso (1991), Carreras (1989), Gómez Mendoza (1985a) and Anuario(s) Estadístico(s). Carreras' output estimates have been revised upwards with Gómez Mendoza's estimates over 1855-1914. For 1850-1854, the output level of 1855 was accepted as a crude approximation.

the case of Spain, was introduced in the investment series.[162] Feinstein's price index (adjusted for exchange rate fluctuations between the sterling and the peseta) was used for 1850-1920 and a deflator was built using weighted input prices for 1920-1958.[163]

For capital formation in road vehicles (excluding automobiles owned for private use which are classified as consumer goods) domestic output (since 1946) plus imports (since 1906) were added up and backcasted to 1900 with yearly registered vehicles.[164] A deflator was built up with input prices for labour and construction materials.[165]

Current price series of fixed capital formation on transportation material were obtained through backwards projection of the 1958 levels for each of its components (derived from CNE58 and TIOE58) with their quantity and price indices that were, in turn, aggregated into a single series.[166] Quantity investment indices were constructed with 1913, 1929, and 1958 weights, and a single index was obtained as a variable weighted geometric mean. An implicit deflator was computed from current and constant price indices.

IV.2.1.4 *Other Material*

Machinery and equipment are the main components under this category, including electrical implements, tractors, office equipment and furniture, research equipment, construction and mining material, and school and hospital material. Dearth of data precludes estimating capital formation except for electric and non-electric machinery and equipment.

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[162] Cf. Feinstein (1988: 338-339). The position of Britain as a major shipbuilder and the fact that Spain's fleet was imported to a large extent over the studied period justifies accepting the British quality index for Spain. I adjusted it to Spain's case by extending the yearly rate of quality improvement for 1901-1913 (0.83%) up to 1936, with no change over 1936-1950, and a slight increase in the rate (to 1%) for 1950-1958.

[163] Prices for 1850-1920 are presented in Feinstein (1988: 338-339, col. 5). For 1920-1958, input prices are weighted according to the 1958 input-output table (TIOE58), 0.38, engineering wages; 0.62, steel prices.

[164] The sources are López Carrillo (1998), Apps. 1-7 (registred industrial vehicles, 1945-1958; imported vans, 1925-1945) and Estadística(s) de Comercio Exterior.

[165] TIOE58 weights are 0.23, engineering wages; 0.77, steel prices.

[166] The 1958 level of capital formation on transportation material is provided in CNE58 and was distributed among its components using TIOE58.

Mains and other plant and machinery were assumed to represent 85 per cent of total investment outlays in electricity supply.[167] As capital stock was highly correlated with installed power, first differences in kilowatts of installed capacity were, hence, accepted as a proxy for new capital formation to which scrapping was added in order to obtain total capital formation.[168] Scrapping was derived assuming an average assets life of 30 years.[169] The deflator was constructed with input prices (copper, 0.5; engineering wages, 0.5) (Feinstein, 1988).

Investment on telephone equipment and plant was obtained by assuming it represented 85 per cent of total capital outlays by Spanish telephone company for the years 1924-1958.[170] A constant price series was computed with a deflator constructed with inputs prices and weights from the 1958 input-output table (TIOE1958).[171] Real investment was backcasted to 1903 with an investment index built from first differences in the number of telephone lines plus scrapping under the assumption of 30 years average (Feinstein, 1988: 354).

As for non-electric machinery, while quantities and values are available for imports, no historical series exists for the production of machinery.[172] I have backcasted the level for 1958 with the rate of variation of an index of input consumption in the engineering industry computed through the commodity flows method. Iron and steel output plus net imports, from which iron and steel consumption in the construction of dwellings, shipping and railway rolling stock was deducted, are the basic series available to compute the

[167] Distinguishing between buildings and plant and equipment is difficult, and I had to estimate capital formation for structures and plant and machinery from the same installed capacity series (see the section on other constructions and works). Investment expenditure is available since 1953 (Banco Central, 1961). The series of installed power cover the period 1901-1958 and the sources are Reseña Estadística and Anuario(s) Estadístico(s). Given the high correlation (0.987 over 1901-1935) between electricity output and installed power, the former was used to backcast the estimates to 1890. Electricity output comes from Carreras (1989).

[168] Negative first differences were excluded. A two-year average, Yt=0.5Xt-1+0.5Xt, was computed to smoothing investment.

[169] Asset life for electricity supply means and other plant and equipment are 25 and 20 years respectively in the British case (Feinstein, 1988: 305). I assumed a longer average life, 30 years, in the case of Spain.

[170] Investment expenditure by Spanish telephone monopoly was kindly provided by Nelson Álvarez.

[171] Weigths, according to TIOE58, were 0.25, copper; 0.25, steel; 0.5 engineering wages.

[172] Unfortunately, such difficulty is frequent in historical studies. See, for example, Cairncross (1953), Lewis (1978), and Feinstein (1988) for the U.K., and Smits et al. (2000) for the Netherlands.

output of machinery and equipment.[173] A three-year moving average for the iron and steel available for machinery industry's consumption was computed to allow for stocks and, then, a quality adjustment of 0.5 per cent per year was applied.[174] A machinery output deflator was constructed by combining engineering wages and steel prices with 1958 input-output weights.[175]

As for other components of fixed capital formation, investment on 'other material' (machinery and equipment) at current prices were obtained by extrapolating 1958 levels backwards with quantity and price indices for its components that, later, were added up into a single series.[176] Real indices for investment in machinery and equipment were constructed with its components' volume indices using 1913, 1929 and 1958 weights, and a compromise index was reached through variable weighted geometric mean. An implicit deflator was derived from current and constant price series.

Gross domestic fixed capital formation at current prices was obtained by adding up its components' nominal value. Quantity indices for fixed capital formation were constructed combining its main components at 1913, 1929 and 1958 prices that were, in turn, spliced into a single index using a variable weighted geometric average. An implicit deflator was derived from current and constant price series.

In order and to keep consistency with post-1958 national accounts, fixed capital formation was distributed into four main categories, residential structures (dwellings),

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[173] The estimates of iron and steel consumption in rolling stock and shipbuilding were computed using conversion coeeficients provided by Gómez Mendoza (1982, 1985a, 1985b). For dwellings, Schwartz (1976) provides the iron and steel consumption per building in 1958 that has been downward adjusted for earlier years when the consumption of iron and steel was significantly smaller.

[174] The form of the moving average is Yt=(Xt-2+Xt-1+Xt)/3. The quality adjustment or allowance, as Feinstein, put it, "for the upward trend in the degree of fabrication" has been previously employed in Lewis (1978) and Feinstein (1972, 1988).

[175] According to TIOE58, weights were 0.44, engineering wages; 0.56, steel prices. For machinery imports, the plant, machinery and equipment deflator for Britain constructed by Feinstein (1988) was adopted over 1850-1920 (adjusted for exchange rate fluctuations between the sterling and the peseta). After 1920, an input cost index was used with equal weights for engineering wages and steel plates.

[176] The level of capital formation on other materials for 1958 provided in CNE58 was distributed among its components using 1958 Input-Output Table (TIOE58).

non-residential structures (other buildings and other constructions and works), transportation material, and machinery and equipment.[177]

IV.2.2 Variations in Stocks

Purchases of raw materials for further elaboration, work in progress, or partially transformed products that are not on sale unless a final transformation takes place, plus stored finished goods for future sale, are all included in this category. Variations in livestock, in agriculture, trade, and manufacturing also are taken into account.

Lack of historical data on inventories has frequently forced researchers to look for short-cut estimates. In their pioneer contribution on the British case, Jefferys and Walters (1955: 7) assumed that the annual variation in the stocks value was "equal to 40 per cent of the first difference between national income estimates in succesive years". Feinstein (1972, 1988) assumed, in turn, that the ratio of stocks to output was stable over time and, hence, the change of final expenditure corresponded to stock building. For Spain, a similar approach was followed, and I accepted the rate of variation of final demand at current prices (GDP at market prices, derived from the output approach, plus imports of goods and services) to approximate stock building and spliced it to the level of variations in stocks in 1958 (CNE58). A wholesale price index was used to deflate the series.

Lastly, variations in stocks were added to gross domestic fixed capital formation to obtain total domestic investment.

IV.3 Net Exports of Goods and Services

To compute GDP from the expenditure side the net value of goods and services supplied to the rest of the world (excluding net returns to factors of production) should be added to consumption and capital formation. Two main categories are included under this label, net exports of goods and services and non-residents expenses in Spain (net of resident expenses abroad). Free on board (f.o.b.) value of goods exported and imported, commodity transport services provided by residents to foreigners, and by foreigners to residents; and other incomes (insurance, communications, patents' royalties) derived

[177] Dwellings were split from "other buildings" by projecting their benchmark levels with the same volume index for "dwellings and other buildings" and, the resulting "other buildings" series was, then, was added to "other constructions and works" to conform an index for non-residential structures. The investment levels for each type of capital formation in 1958 were obtained from TIOE58.

from non residents, and those paid by residents, are considered under traded goods and services. Under the second label are included: consumption expenses in Spain by non residents less expenditures of residents abroad, payments by non residents to nationals for passenger transport services net of those payments by residents to foreign passenger carriers, and any other net expenses by non residents within Spanish boundaries.

Current values of exports and imports of goods and services for 1940-1958 are from Elena Martínez Ruíz (2003).[178] For the period 1850-1939, the sources and procedures used to construct current values for the main components of exports and imports of goods and services are briefly described below.

IV.3.1 *Net Exports of Goods*

Free on board (f.o.b.) value of goods exported and imported needs to be computed. Data from Spanish official trade statistics have been corrected for quantity underestimation and price biases through a comparison of Spanish trade with its main trading partners on the basis of foreign and Spanish trade statistics by Prados de la Escosura (1986) for 1850-1913 (who included an estimate of smuggling through Gibraltar and Portugal), Antonio Tena Junguito (1992) for 1914-1935, and Martínez Ruíz (2003, 2006) for 1936-1939. Cost, insurance, and freight (c.i.f.) imports were converted into f.o.b. imports to comply with balance of payments conventions.[179] In addition, exports and imports were grossed-up to include the Canaries while trade between these islands and the Peninsula was excluded.[180]

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[178] The autor kindly supplied her data.

[179] Official imports for 1850-1913 have been now corrected with a coefficient derived from a sample of Spain's main trading partners instead of with coefficients obtained from commodity and country samples for primary products and manufactures, respectively, as in Prados de la Escosura (1986). The change was introduced to maintain consistency with Tena Junguito (1992) and Martínez Ruíz (2003) estimates for 1914-1958. It must be stressed that the new results are almost identical to the earlier ones. Minor changes have also been introduced in Tena Junguito (1992) series by choosing different freight indices in the construction of freight factors. Thus, the 1913 export freight factor (ratio of freight costs to the value of commodities traded) from Prados de la Escosura (1986) has been extrapolated with iron ore freights (from (1998), expressed in index form, as the numerator, and the export price index, as the denominator. As regards imports, Tena Junguito (1992) freight factor for 1926 has been projected over time with a freight index computed as a trade weighted average of coal and wheat freights (tons imported are the weights) and the import price index.

[180] Neither Tena Junguito (1992) nor Martínez Ruiz (2003) included the Canary Islands into their Spanish trade estimates. I re-scaled their revised trade series with the Spain and Canary Is. to Spain ratio. This

IV.3.2 *Gold and Silver*

Quantities of gold and silver as recorded in trade statistics (coins, bars, and paste) are considered as monetary gold and silver and, therefore, non-monetary gold and silver trade was not included in the estimates of net exports of goods and services.[181]

IV.3.3 *Freight and Insurance*

Freight income received for exports carried in Spanish ships less freight expenses paid for imports transported in foreign vessels constitute the first item to be computed under this label. Following North and Heston, the freight-value method, or freight factor, was preferred to the earnings per ton method.[182] Total freight revenues on exports and imports were first computed by applying freight factors to the f.o.b. value of exports and imports and, then, to ascertaining freight income on exports (a credit for Spain) the share of tonnage exported carried under Spanish flag was used, while the share of imported tonnage in foreign ships was employed to computing freight expenses on imports.[183] In addition, freight income from carrying trade between foreign ports was assumed, following North (1960) and Simon (1960), to represent a percentage of freight earnings and a 10 per cent of freight income on exports was accepted.[184] Port outlays by Spanish ships in foreign ports and by foreign ships in Spain's harbours as payments for port dues, loading and unloading expenses, and coal are assumed to represent a fixed share of shipping earnings and expenses.[185] Foreign ships transported more tonnage than in Spanish vessels as they exhibited, according to Valdaliso (1991: 71), a more efficient

procedure implies the arguable assumption that quantity and price biases in Peninsular Spain (and Balearic Is.) trade are similar to those in Canary Is. trade.

181 There are serious doubts about how gold and silver exports and imports were recorded in official trade statistics (Tortella, 1974: 121-122). It could be argued that, since Spain never was part of the Gold Standard, trade in gold and silver should be treated as non-monetary. The fact that Spain behaved in practice as country member of the Gold Standard led me to consider gold and silver exports and imports as monetary.

182 North and Heston (1960). Cf. also Simon (1960) to whom I tried to follow as closely as the data permitted. Freight factor is the ratio of freight costs to the current value of traded commodities.

183 Freight factors are taken from Prados de la Escosura (1986) for 1850-1913 and from Tena Junguito (1992), revised according to the procedure described above, for 1914-1939. The distribution of tons exported and imported between Spanish and foreign ships for 1850-1935 comes from Valdaliso (1991). I assumed the distribution for 1940 (in Anuario Estadístico) was representative for the Civil War years.

184 Alternatively, Sudrià (1990) estimates for the period 1914-1920 are available in those cases in which the earnings per ton method were used. No substantial differences emerged from the two methods with Sudrià's showing lower levels.

185 For similar assumptions for the U.S. and the Netherlands, cf. Simon (1960) and Smits et al. (2000).

transport capacity ratio. I assumed that more fully loaded vessels made smaller outlays per ship and, hence, port outlays by Spanish ships abroad (a debit) were established at 30 per cent of the freight income on exports, while port outlays by foreign ships in Spain (a credit) were fixed at 20 per cent of freight expenses on imports.[186] Finally, marine insurance income and expenses were computed under the widely shared assumption that underwriting follows the flag and exports in Spanish ships were, hence, usually insured by Spanish companies while imports in foreign vessels were insured by foreign companies.[187] I arbitrarily assumed that insurance rates were identical by Spanish and foreign companies and accepted those used by Prados de la Escosura (1986) for 1850-1913 and by Tena for 1914-1939, to which I added an extra 2 per cent to include shipping commissions and brokerage.[188]

IV.3.4 *Tourism, Emigrants' Funds, Passenger Services, and Other Services*

Yearly income from tourist services was derived on the basis of expenses per visitor (net of Spanish tourist expenses abroad) calculated by Jáinaga for 1931, times the annual number of tourists and, then, reflated with a cost of living index to obtain current price estimates.[189] Unfortunately, the total number of tourists is only known since 1929 and was backward projected to 1882 with the rate of variation of passengers arriving by sea, while no tourism was assumed to exist over 1850-1881.[190]

Spain was a net emigration country over the late nineteenth and early twentieth century (Sánchez-Alonso, 1995, 2000). Emigrants carried small sums with them to cover their arrival expenses. It can be reckoned that, in 1931, emigrant funds to America

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[186] The idea that more fully loaded ships made smaller outlays is taken from Simon (1960). These figures roughly correspond to those accepted by Smits et al. (2000).

[187] This assumption is borrowed from Simon (1960). It could, however, overexaggerate Spain's earnings from marine insurance, as it was rather common for Spanish ships to be underwritten by foreign companies.

[188] Tena Junguito (1992: 39), assumed a constant 0.5 per cent of trade value for 1914-1939. I accepted his estimate for 1920-1935 but assumed that the insurance rate evolved with the freight factor over the World War I and the Spanish Civil War years.

[189] Jáinaga (1932) reprinted in Velarde (1969). Tourist numbers from 1929 onwards are taken from Fernández Fúster (1991). The implicit assumption here is that real expenses per tourist remained constant tourists over time. The implicit assumption here is that real expenses per tourist remained constant over time. The cost of living index has resulted from splicing Ojeda's (1988) index for 1909-13 with Reher and Ballesteros (1993) for the previous years.

[190] For passengers arriving by ship, cf. Nicolau (2005). The low numbers in the early 1880s allows the presumption that tourism was not economically significant by mid-nineteenth century.

represented, on average, 200 gold pesetas, that is, 400 current pesetas, including the fare and small amounts to cover arrival expenses.[191] If the fare represented around 340 current pesetas, 60 pesetas corresponded to emigrant's funds.[192] However, its author only added "a small amount for unavoidable expenses", to the cost of the passage, and this sum is most likely an underestimate.[193] I, therefore, accepted a higher estimate of 100 pesetas for those emigrating to America and one-tenth, 10 pesetas, for those to Algeria (and to France) in the eve of World War I.[194] These average sums times the number of emigrants to America, Algeria and France cast a yearly series of emigrants' funds that was reflated with a wage index.[195]

In addition, revenues and expenses from passenger transport have to be taken into account. Fares paid by tourists carried by Spanish ships and by immigrants returning in Spanish vessels are included on the credit side, while fares paid by emigrants to foreign shipping companies represented a debit. The number of migrants provided by Sánchez-Alonso (1995) for 1882-1930 was completed up to 1939 with Spain's official migration statistics and those from the main destination countries, plus an estimate of migration for the years 1850-1881 on the basis of scattered foreign evidence.[196] The share of arrivals

[191] Computed from Jáinaga (1932).

[192] Vázquez (1988) provides third class fares to Cuba (325 pesetas), Argentina and Brazil (356 pesetas) in 1930 that yield an average of 340 pesetas.

[193] This figure, 60 pesetas, corresponds to a lower bound estimate of the average funds brought by Italian inmigrants into the U.S.A. in 1892, according to Simon (1960: 676-677).

[194] The one-tenth ratio derives from comparing fares to America (Vázquez 1988) with those to Algeria (Ministerio de Trabajo 1935) in 1934. These are rougly similar to the lower bound figures produced by Marolla and Roccas (1991: 252), for Italian emigrants to America and Europe in 1911. Llordén (1988: 62), on the other hand, provides a larger sum for Spanish emigrants' funds in the 1860s, 125-200 pesetas, once the fare is deducted.

[195] Agricultural wages (Anuario(s) Estadístico(s)) were used for 1913 and 1925-1939, and were linked to mason wages for the rest of the time span considered (Reher and Balleste 1993).

[196] For 1850-1881, figures of Spanish inmigration in Argentina, Uruguay, Brazil, and the U.S.A., provided by these countries' official statistics were completed with emigration to Cuba in 1860-1861 from *Anuario*(s) *Estadístico*(s) that was assumed to remain constant over the period. Emigration to Algeria was derived from Spanish arrivals in Alger and Oran for the years 1872-1881, while the figures for 1850-1871 were estimated under the arbitrary assumption that the share of emigrants remaining in Algeria after one year were similar to the one over the period 1872-1881 (25 per cent). Estimates for returned migration was computed by assuming that the average returns from America for 1869-73 were acceptable for 1850-1868 while 92 per cent of emigrants to Algeria returned home within the first year. A consistency check of the yearly migration data was performed using the migration balances from population censuses along the lines described in Sánchez-Alonso (1995). Data for returned migration from America, 1869-1881, was taken from Yáñez (1994: 120). Data on presents the data on migration to Algeria, 1850-1881 comes from Vilar (1989).

and departures in Spanish and foreign ships is provided by official migration statistics from 1911 onwards, and shows a stable pattern, roughly one third of emigrants returned home under Spanish flag and three-fourths left in foreign ships, except during World War I when the distribution pattern was reversed.[197] These shares were accepted for the nineteenth and early twentieth century. The fares for trips to Argentina, Cuba, and Algeria are obtained from Vázquez, Llordén, and official emigration statistics.[198]

Lastly, Government transactions (credits and debits) were taken from official accounts were added up (Instituto de Estudios Fiscales, 1976).

Total exports and imports of goods and services at current prices were reached by adding up its components. Constant price values were obtained with price indices for commodity exports and imports.[199]

IV.4 Gross Domestic Product at market prices

A yearly series of nominal Gross Domestic Product at market prices was obtained by adding up individual indices for private and public consumption, capital formation, and net exports of goods and services. A GDP volume index was constructed by weighting each expenditure series with their shares in nominal GDP in 1958. An implicit deflator was derived from current and constant price GDP series.

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[197] Ministerio de Trabajo (1934: 491) provides data for 1925-1934. Consejo Superior de Emigración (1916) offers evidence for 1911-1915. The actual per centages used were 0.354 for returned migration under Spanish flag (0.646 for World War I years) and 0.764 for emigrants in foreign ships (0.276 during World War I).

[198] Cf. Llordén (1988) for fares to Havana over 1862-1876; Vázquez (1988) provides lowest fares to Cuba, Brazil and Argentina for 1880-1930 at 1913 prices that have been reflated to obtain current price fares using the same Sardá (1948) wholesale price index he employed to derive constant price fares. Missing years were interpolated (1862 fares to Cuba were accepted for 1850-61; fares to Argentina prior 1880 were assumed to moved along fares to Cuba). I assumed that fares to Algeria moved along the fares to America and that the fares ratio Algeria/Argentina in 1934 (Ministerio de Trabajo, 1935) was stable over the considered period. I also assumed that tourist fares from Europe moved along migrants' fares.

[199] Export and import price indices for 1850-1913 are provided by Prados de la Escosura (1988), where a chain price index for Spanish exports to Great Britain was accepted as Spain's export price index, and an average of export price indices of Spain's main partners weighted by their shares in Spanish imports was employed as import price index. For the years 1914-1958 the export price index is taken from Anuario(s) Estadístico(s) and the import price index has been computed as an average of export price indices of Spain's main partners weighted by their shares in Spanish imports. The deflation of current values has been preferred to the avaliable quantity indices for 1914-1958, as the latter are built up on the basis the official trade statistics in which quantities and prices are mismeasured (Cf. Tena Junguito, 1992).

However, the resulting GDP estimates from the demand side do show discrepancies with those obtained through the supply side. As discussed before, it is widely accepted that both in present time developing countries and in historical accounts measurement errors are smaller when GDP is computed from production rather than from expenditure.[200] Hence, I have chosen GDP derived from the output approach as the control final and adjusted private consumption (both at current and constant prices), the largest expenditure component, so GDP from the expenditure side equals to GDP derived through production.[201] The consumption structure remained, however, unchanged.

IV.5 Gross National Income

Net payments to foreign factors must be added to gross domestic product in order to compute gross national income. Martínez Ruíz (2003) provides the data for 1940-1958. Jáinaga's contemporary estimates of net factor incomes, converted from gold to paper pesetas, were accepted for 1931-1934.[202] Due to dearth of data only very crude estimates of foreign capital incomes (dividends and interest payments to private foreign capital and external debt service), on the debit side, and of Spanish labour returns abroad (wages and salaries), on the credit side, could be carried out. These are the main components of net factor payments abroad, as neither Spanish investments abroad nor foreign labour in Spain were significant over the long period considered.

Assessing returns to Spanish labour employed abroad is a complex task because labour incomes (wages and salaries), the relevant concept for GNI estimation, have to be distinguished from emigrants' remmitances, a variable not included in the calculation.[203] Actually, such a distinction can only be made since 1917. For the period 1850-1913, I accepted that only 5 per cent of those migrating to America and 60 per cent of those

[200] Statistical evidence on production seems to be more reliable than on expenditure or income. Heston shows that more than 80 per cent of developing countries use the production side GDP as their control total. Assessments of Spanish national accounts prior the mid-1960s concur with this view (Schwartz, 1976: 456; Uriel and Moltó, 1995: 73). Historical national accounts estimates confirm this assertion, see, for example, Baffigi (2013), van der Eng (1992: 348), and Batista et al. (1997) on the cases of Italy, Indonesia, and Portugal, respectively.

[201] By 'control total' is meant that 'estimates from alternative approaches are adjustred to conform to this total' Heston (1994: 33).

[202] Cf. Chamorro and Morales (1976) where Jáinaga's full set of estimates were published. Velarde (1969) reprinted Jáinaga (1932) balance of payments estimates for 1931.

[203] Net current transfers are needed in order to compute Net National Disposable Income.

migrating to Algeria returned within the year.[204] The next step was to assess the amount that, on average, was brought home by returning Spanish workers after one year, or less, away from home. I computed an average sum that was taken home by the temporary emigrant or sent annually by the long-term emigrant to their relatives and friends.[205] García López (1992) presents the most comprehensive estimates for the years prior to World War I, 250-300 million pesetas as an annual average over 1906-1910, that amounts to 340-400 pesetas per emigrant (either returning home or sending remmitances). I accepted 400 pesetas per emigrant as a benchmark that was, then, projected backwards and forward with a nominal wage index constructed for the destination countries and adjusted for exchange rate between the peseta and each destination country's currency.[206] Finally, returns to Spanish labour abroad were obtained by multiplying the annual sum per head times the number of emigrants returning home within their first year abroad.

On the debit side, three main items can be distinguished: the external debt service, dividends and interests paid to railway shares and debentures owned by foreigners, and returns to foreign factors in mining, to which crude estimates of incomes paid to foreign

[204] Evidence on transatlantic emigrants returned after less than a year abroad is presented in Yañez (1994) for 1917-1921 and 1925-1930 and in Ministerio de Trabajo (1935: 14) for 1926-1934. It represents between 3.5 and 6.2 per cent of total emigration to America, averaging 5 per cent. Yáñez (1994: 225-227) provides higher shares, 7.8 and 6.6 per cent for 1917-1921 and 1925-1930, respectively. I accepted the average for 1917-1918 for 1914-1916 and the share for 1934 was extended to 1935. For the period 1850-1913 I accepted 5 per cent and for 1922-24 I log-linearly interpolated the percentages for 1921 and 1925 while no return emigrants were assumed during the Civil War (1936-39). For the share of emigrants to Algeria returning within a year, Bonmatí (1988: 135) points to 59 per cent of total emigrants.

[205] Unfortunately, no distinction can be made between short- and long-term migrants. Contemporary estimates are collected in Chamorro (1976), for 1899, 1900 and 1904; Vázquez (1988) for 1906, 1908-1913 and 1920-1922; and García López (1992), averages for 1906-1910 and 1920-1921. Lastly, those by Jáinaga for 1931-1934 were reprinted in Chamorro and Morales (1976).

[206] Nominal wages for Argentina are collected in Williamson (1995). Zanetti and García (1977) provide nominal wages for Cuba from 1903 onwards. French nominal wages from Williamson (1995) are used for emigrants to France and Algeria. The trading exchange rates of the peseta against the peso, the French franc and the US dollar are computed on the basis of Cortés Conde (1979), Della Paolera (1988), and Martín Aceña and Pons (2005). I assumed that no labour returns were sent home during the Civil War years (1936-39).

capital invested in insurance, tramways and utilities, were added for the twentieth century.[207]

Service payments on the external debt have been computed by applying specific interest rates to each class of Government bonds.[208] After the debt conversion of 1882 in which existing foreign debt was given in exchange for new bonds (at 43.75 per cent of its nominal value), and simultaneously with the abandonment of gold convertibility of Spanish currency, debt repatriation started as Spaniards found more secure to invest in bonds serviced in gold pesetas as a shelter against currency depreciation.[209] Since 1891, when the peseta's depreciation took actually place, Spanish citizens purchased external debt bonds while foreign bondholders were trying to get rid of them. A Government measure intended to cut short such a trend was the introduction of the so called 'affidavit' in 1898, which implied that only non-resident bondholders would continue receiving their interests in gold pesetas (or francs), while the rest would be paid in current pesetas (and offered to convert their external debt bonds into internal debt). As a result, the external debt fell, in 1903, to 52.7 per cent of its volume in 1898; in other words, it proves that Spanish residents had purchased almost half Spain's external debt between 1891 and 1898. Hence, only half of the interest paid (52.7 per cent) on external debt should be computed as payment to foreign capital invested in external debt over 1891-1898. Moreover, in so far debt service was in gold pesetas, the amount of interests paid (obtained by applying the interest rate to foreign debt in non residents' hands) had to be increased by the depreciation rate of the current peseta with respect to the gold peseta over 1891-1914.[210] After World War I, unlike the experience of the 1890s, Spanish foreign debt in foreign hands tended to disappear. I have computed the share of interest payments that accrued to foreign citizens on the basis of Banco Urquijo data.[211]

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[207] Muñoz et al. (1978: 209-213). Electricity alone represented 19 per cent. Foreign capital in railways and mining reached 42 per cent of the total. Altogether, the sectors included here constituted two-thirds of all foreign capital invested in Spain in 1923.
[208] External debt and the interest rates applied are provided in Fernández Acha (1976).
[209] Cf. Sardá (1948) for a detailed evaluation of Spain's external debt in the late 19th and early 20th century.
[210] The exchange rate of the peseta against the French franc is provided in Martín Aceña and Pons (2005).
[211] Banco Urquijo (1924) provides evidence on the declining share of Government bonds in non-residents hands during the post-World War I years.

Fortunately for the purpose of this study, railways companies were highly concentrated and the detailed studies by Pedro Tedde de Lorca provide enough evidence to estimate dividends on share capital and interests on debentures paid to non-residents.[212] Dividends paid to shareholders and interest payments on debentures issued by the three major railway companies are available from the mid-nineteenth century up to the Civil War.[213] Both the percentage represented by the three main companies in total capital invested in railways and the proportion of railways capital in foreign hands have to be ascertained in order to compute the returns to foreigh capital invested in Spanish railways. Tedde de Lorca (1978, 1980) provides total capital shares and bonds held by the three major companies and its proportion in total investment, and, based on Broder's research, also the participation of French capital in total capital invested in 1867, at the time of network construction, and over the nineteenth century. Broder's (1976) estimates of foreign investment in railways allowed, in turn, to gross-up French railways capital to cover all foreign capital. For the interwar years I have had access to estimates of the proportion of shares and debentures in non-resident hands.[214]

Foreign capital in mining was mainly British. On the basis of effective capital invested by British companies and cumulated total foreign investment in mining, it can be suggested that, over 1870-1913, more than half of all foreign capital in Spanish mining came from the U.K. while the British share raised to three-fourths in the interwar years.[215]

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[212] Cf. Tedde de Lorca (1978, 1980) for research on Norte, MZA and Andaluces, the three main railway companies. Evidence on foreign investment in railways has been gathered in Broder (1976).

[213] Tedde de Lorca (1978), Appendices IV-9 and IV-18 provides the data on dividends and interests paid by Norte and MZA, while Tedde de Lorca (1980), pp. 44-45, presents the same evidence for Andaluces.

[214] The information on the shares deposited in order to participate in MZA shareholders meetings (1891-1935), comes from Pedro Pablo Núñez Goicoechea who kindly provided it to me. Vidal Olivares (1999: 628-639) presents similar information for scattered years for the Norte railway company. Tedde de Lorca (1980: 31-34) offers quantitative evidence on the decline of debentures in foreign hands during the interwar years.

[215] Cf. Harvey and Taylor (1987: 197), for British capital (effective share capital and debentures and mortgage bonds). Cumulated total foreign investment (excluding railways) and cumulated French investment in mining was derived from Broder (1976). When only French and British capital in mining are considered (the large majority of it), the British share ranged from 63 to 73 per cent over 1870-1900, the mining boom era (and only 22-41 per cent in the earlier period 1851-70). When, alternatively, Broder's estimates of non-railway investment from other countries are cumulated, British capital represented from 52 to 61 per cent over 1870-1900 (22-31 per cent in 1851-70). Evidence in Muñoz, Roldán and Serrano (1976) indicates that British capital was above 50 per cent in the years 1900-1913 (53 per cent on average for 1900 and 1912), while its contribution rose up to three-fourths in the interwar years (76.6 per cent on average for 1923 and 1931).

Decadal averages of dividend and interest payments to British companies are provided by Harvey and Taylor that were grossed-up to include all payments to foreign capital in Spanish mining for 1851-1913, assuming similar rates of return in non-British foreign investment, and using the estimated British participation in total foreign capital.[216] Estimates of foreign capital returns in mining derived through this procedure were, then, distributed annually with an index of non-retained value in Spanish mineral exports.[217] Dividend and interest payments from 1914 onwards were estimated by projecting the average level for 1911-13 with an index of non-retained export proceeds.

Finally, crude estimates of incomes paid to foreign capital invested in tramways, electricity, gas and water supply, and insurance were carried out through backwards extrapolation of an estimate for 1931-34 (Jáinaga) with the rates of variation of their output.[218] For foreign insurance companies, the volume of declared premia times the yield of British consols provided their yearly returns.[219]

The difference between credit and debit estimates provided the value of net payments to foreign factors abroad. To derive constant price series the import price index was used as a way of assessing its purchasing power.[220] Gross National Income was, in

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[216] The British participation in total foreign capital was assumed to be 30 per cent in 1850-1870, 60 per cent in 1870-1890, and 50 per cent in 1890-1913 (see the previous footnote for justification).

[217] Non-retained exports represent the value of exports receipts that accrued to foreign productive factors used in mining production and, therefore, are not kept in Spain. Non-retained values over total mineral export proceeds represent 0.35 for iron ore, 0.40 for lead, 0.49 and 0.625 for copper pyrites before and after 1896, 0.54 for mercury, according to Prados de la Escosura (1988) who took them from González Portilla (1981), Broder (1981), Harvey (1981) and Nadal (1975), respectively. Recent revisionist work by Escudero (1996) suggests that these shares should be revised upwards and Témime, Broder and Chastagneret (1982) pointed out that 70-75 per cent of export proceeds were not retained in Spain. Escudero (1998) has estimated that the share of foreign returns in Basque iron ore mining represented 39.5 per cent (204 million pesetas) of its total over 1876-1913, to which should be added the differential between market prices and much lower preferential prices (that foreign mining companies charged their matrix firms abroad) times the quantities sold at preferential prices, approximately 200 million pesetas, so the share of non-retained exports would be over half of total export proceeds. I have used, then, non-retained shares of 0.55 for iron ore, 0.90 for lead, and 0.73 for pyrites.

[218] Tramway revenues are provided in Gómez Mendoza (1989). For utilities, see section III.

[219] Frax and Matilla (1996) provide the declared value of insurance premia by foreign companies for 1907-1937 that was backasted with the number of foreign companies to 1850. The yield of British consols was taken from Mitchell (1988).

[220] I follow Feinstein (1972) who suggested deflating those components of the balance of payments for which no specific deflators are available by an import price index to ascertaining their purchasing power.

turn, computed adding net factor payments abroad to Gross Domestic Product at market prices.

IV.6 Net National Income

Net National Income was obtained by substracting capital consumption –provided in Prados de la Escosura and Rosés (2010a)- from Gross National Income.

IV.7 Net National Disposable Income

Net National Disposable Income was derived by adding an estimate of net transfers to the rest of the world to Net National income. Emigrants' remittances constituted its main historical component in Spain. Not all emigrants sent money home while being abroad. In historical estimates it is usually acepted that most of those who established themselves abroad stopped sending money after five or six years either because they have already payed for their debts or because they planned to invest in the receiving country. I arbitrarily assumed that emigrants only sent money home within their first five years and computed emigrants' remmittances by multiplying the estimated average sum per emigrant times the cumulative figure of emigrants arrived in the last five years, after deducting those migrants who returned home within one year.[221]

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[221] Following Simon (1960) I have attributed double weight to the last yea of each five-year period considered. Due to lack of data, no distinction has been made between the sum brought back home by the emigrant who returned home within his/her first year abroad and the average remittances sent during the five first years abroad by the rest of emigrants.

V. NEW GDP SERIES AND EARLIER ESTIMATES FOR THE PRE-NATIONAL ACCOUNTS ERA

How do the new GDP series compare to earlier estimates? [222] Let us examine them first. Unlike contemporaries who were interested in assessing national income levels, early Spanish research has been concerned with trends and fluctuations in real output and expenditure.[223] All available GDP estimates are output indices constructed with a fixed, single benchmark level whose economic significance tends to decline as one moves away from the base year.[224] Moreover, trends in real gross value added are proxied by production indices, which implies the unlikely assumption that total output and input consumption evolve in the same direction and with the same intensity.[225] Three types of yearly GDP estimates can be distinguished: Official estimates by the Consejo de Economía Nacional, its revisions and extensions, and independent estimates.

V.1 Consejo de Economía Nacional Estimates

In 1944, the Consejo de Economía Nacional or National Economic Council (CEN, thereafter) was asked to estimate a set of national accounts for Spain (CEN, 1945, 1965). Three were the main targets: to provide income figures for the years prior to the Civil War (1936-1939), to evaluate 1940 GDP on the available, fragile statistical basis, and to design a direct method to estimate national income for the years to come (Schwartz, 1977: 460).

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[222] Attempts to provide historical GDP at benchmark years have been carried out by economic historians. Bairoch (1976) and Crafts (1983, 1984) included Spain in their estimates for the nineteenth century computed along Beckerman and Bacon (1966) indirect approach. Following Deane (1957), Prados de la Escosura (1982) reconstructed Mulhall (1880, 1884, 1885, 1896) figures in a consistent way and derived a set of benchmark estimates for Spanish national income for 1832-1894. In addition, GDP estimates for seven benchmarks over the period 1800-1930, from the industry of origin approach are provided in Prados de la Escosura (1988).

[223] It is worth mentioning Mulhall (1880, 1884, 1885, 1896) estimates of national income for a large number of countries, including Spain, in the late nineteenth century. The main contemporary attempts to derive levels of Spain's national income have been collected in Schwartz, ed. (1977). The literature on Italy, where detailed benchmark estimates have been constructed, provides a counterpoint (Rey, ed., 1991, 1992, 2000, 2002).

[224] Unfortunately, the 1958 GDP benchmark is the earliest available in Spain. New, direct GDP estimates for benchmark years prior to 1958, e.g., 1910 or 1930, years for which population censuses are available, would be required to provide a rigorous check on GDP figures derived by projecting benchmarks backwards with quantity and price indices.

[225] The reader should be aware that my own estimates suffered from this bias (see Section III). Actually only a double deflation procedure for inputs and output would provide a correct alternative. By double deflation is meant independent deflation, with their own price indices, of final production and intermediate inputs so real value added is obtained as a residual. Cf. Cassing (1996).

Dearth of data forced CEN to split output indices in two segments with 1929 as the link year. In each case, independent production indices for agriculture and industry were obtained, from which an aggregate index was derived to approximate national income. No regard was paid to services and was implicitly assumed that output in services evolved as a weighted average of agricultural and industrial production.

For the earlier period, 1906-1929, an agricultural output index was built up on the basis of eleven products, mostly dry farming crops (while no livestock output was included), representing half the value of total output. The index of industrial production included eighteen products, rendering a good coverage for mining, but insufficient for manufacturing and construction. Output indices were obtained for agriculture and industry by weighting each single product with its average price over 1913-1928, and the aggregate results were expressed by taking the average for 1906-30 as 100.

The composition of agricultural and industrial indices changed from 1929 onwards. Thirteen new crops were added to the agricultural index, distributed into eight main groups of products, that reached up to 80 per cent of total production, while the industrial index's coverage rose to 38 products distributed into ten different groups.[226] To derive output indices for agriculture and industry, quantities were weighted by 1929 farm-gate prices and unit value added, respectively.[227] Improvements in data coverage took place in the 1950s but the method remained practically unaltered until 1956.

An index of total production was obtained by combining agricultural and industrial indices with fixed weights (0.6 and 0.4, respectively, over 1906-1929, and 0.5 each, thereafter). In addition, to allow for short-term fluctuations over the period 1906-1935, a de-trended nuptiality index was combined with the total production index. Nuptiality was excluded after the Civil War (1936-39) as unsuitable for post-war cycles.

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[226] In order to reduce the downward bias for manufacturing, CEN (1945, 1965) overweighted electricity output.

[227] Mining was allocated 22.68 per cent of total industrial output; utilities (represented by electric energy), 20.96 per cent; and manufacturing only 56.36 per cent. If the size of the industrial sample (2,077 million pesetas) is compared to Banco Urquijo 's estimate of industrial output *circa* 1924, its coverage represents 25 per cent of total industrial value added.

In a second stage, the total production index was linked to an estimate of national income for 1923 in order to derive national income at constant prices.[228] A further step was to obtain national income figures at current prices by reflating real income with a wholesale price index. Finally, for the years 1957-1964, CEN computed national income directly.

V.2 Revisions and Extensions of CEN Estimates

Modern national accounts constructed according to OECD rules are available in Spain since 1954. Attempts to extend them backwards led to revisions of CEN figures that, ocassionally, were expanded to cover the expenditure side. Three estimates are worth mentioning.

V.2.1 *Comisaría del Plan de Desarrollo*

A first attempt to revise CEN's estimates was carried out by Comisaría del Plan de Desarrollo, the Development Planning Authority (CPD, thereafter) and covered the period 1942-1954 (CPD 1972).[229] CPD economists were concerned with the high volatility shown by CEN figures that they attributed to its high dependence on agricultural output and to the exclusion of services. The alternative proposed by CPD was to construct a new index of aggregate performance in which services were added to CEN's indices of agricultural and industrial output. Services output was obtained by combining series on transport and communications and banking.[230] A real product index was calculated by weighting each sectoral index with the shares of agriculture, industry, and services in 1954 GDP at factor cost, as established in official national accounts (CNE58).[231] GDP at constant prices for 1942-1953 was, then, derived through backward extrapolation of the 1954 GDP level with the real product index. GDP at current prices was computed, in turn, by reflating real

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[228] CEN (1945) used an arithmetic average of Banco Urquijo (1924) and Vandellòs (1925) estimates assuming that were independent from each other. Assessments of CEN (1945) income figures are provided by Guerreiro (1946), Hemberg (1955), and Fuentes Quintana (1958), all reprinted in Schwartz, ed. (1977). Hemberg (1955) pioneering computation of income using a production approach showed that there were enough statistical data to carry out a direct estimate of GDP from the supply side.

[229] The purpose of CPD estimates was to provide statistical background for the econometric model used in simulations during the third 'plan de desarrollo', an instrument of *planification indicatif* in the early 1970's.

[230] Fixed value added weights from 1954 National Accounts were accepted.

[231] National accounts are named after the benchmark year used for its construction. Thus, CNE58 is Contabilidad Nacional de España with 1958 as the base year.

output with a composite index of wholesale prices (0.3) and the cost-of-living index (0.7).[232]

GDP was completed with a breakdown of its expenditure components that included direct estimates of investment, public consumption, and net exports of goods and services. To approximate private non-residential fixed capital formation, a physical index of private investment was built up by combining, with 1954 weigths (CNE58), steel and cement output, machinery imports, electric power, and registered transport vehicles. An index of residential investment was proxied by the number of completed dwellings. Public investment, in turn, resulted from adding up investment in agriculture and public works and provincial and local public investment, deflated by a wholesale price index. Levels of each type of investment for 1954 were taken from the national accounts and projected backwards with each investment index to derive real capital formation series and, then, reflated with price indices for production goods and construction materials. Total expenditure of public administration (central, provincial, and local governments) re-scaled to match national accounts, was used for public consumption and, then, deflated with a wholesale price index. Net exports of goods (at current and constant prices) were used as a proxy for net exports of goods and services, except in the case of tourism, in which the number of tourists (and the cost of living index as deflator) was accepted. Private consumption was obtained as a residual from GDP at market prices (derived by adding indirect taxes net of subsidies to GDP at factor cost, obtained through the production approach) and the directly estimated components of expenditure.

V.2.2 *Alcaide*

A revision of CEN series was also attempted by Julio Alcaide, a pioneer of Spanish national accounts, who, concerned for its volatility and cyclical behaviour, attempted to smoothing CEN's real output (Alcaide 1976).[233] For the period 1901-1935, Alcaide derived

[232] The weights tried to reflect the relative importance of private consumption (70 per cent) and the rest of the demand components of GDP (30 per cent).

[233] Alcaide carried out another revision of the historical accounts for the period 1901-1985 that did not challenge, however, his earlier findings for real product in the pre-national accounts period (Banco de Bilbao, 1986). Nevertheless, nominal levels were revised upwards as the historical series were linked to more recent figures from Banco de Bilbao's own GDP estimates. Alcaide (2000) revised his estimates for the early twentieth century, starting in 1898, and spliced them with Fundación BBV's GDP estimates for 1955-

an index of domestic production by combining, with 1906 fixed weights, CEN indices for agricultural and industrial output, and total employment in services, as a proxy for its output.[234] GDP at current prices was obtained by reflating real output with a wholesale price index.[235]

V.2.3 *Naredo*

An apparent inconsistency in the CEN series that would have led to understimating national income for the post-Civil War years motivated José Manuel Naredo's revision of CEN's national accounts (Naredo, 1991). The rationale for the under-registration of economic activity in official national accounts lies in the response of economic agents to systematic regulation and intervention of markets under Francoist autarchy.[236] He also noticed that CEN's implicit income-elasticity of demand for imports in the 1940's was too low. Naredo proposed, then, an alternative real GDP series for 1920-1950 based upon the revision of official national account estimates by hypothesising higher income-elasticity of the demand for imports in the 1940's and by assuming a 10 per cent fall in GDP resulting from the Spanish Civil War (1936-1939).

V.3 Independent Estimates

V.3.1 *Información Comercial Española*

The contribution by the research unit of the Ministry of Commerce and published in its journal, *Información Comercial Española* (ICE, thereafter) represented a major

1998 (also Alcaide's own work). Unfortunately, Alcaide neither discusses his methods nor substantiates his arguments with empirical evidence, while no sources are provided.

[234] Weights were 0.4 for agriculture, 0.25 for industry, and 0.35 for services. Since historical active population figures are only available at census years, either Alcaide interpolated census data or applied participation rates, derived at census intervals, to available yearly figures for total population. Alcaide claimed to having adjusted employment in services "to accute changes in total production" (Alcaide (1976: 1129). As stressed by Tortella (1987), using employment as a proxy for output implies the assumption of stagnant labour productivity in services.

[235] Alcaide's revision of CEN figures for 1940-54 is also far from clear. He relies on a revision of CEN's real output carried out by Tamames without providing the reference. Moreover, while in the case of GDP only the wholesale price index seems to have been used, it appears that Alcaide reflated real national income with the cost of living and wholesale price indices weighted by the shares of consumption and investment in 1954 national accounts, respectively.

[236] Naredo (1991) illustrated his argument by refering to the 26 per cent increase in agricultural output in a single year (1951), following the abolishment of food rationing, which partially liberalised the domestic market.

improvement over earlier indices of Spanish aggregate performance (ICE 1962).[237] The "general index of total production", as its authors named it, covered 1951-1960 and represented a Laspeyres volume index in which three major sectors, agriculture and fishing, mining, manufacturing and construction, and trade and services, were combined with 1958 gross value added as weights. For each sector a Laspeyres volume index with 1958 weights was constructed, in which four branches were included for agriculture, sixteen for industry, and six for services, the latter appearing for the first time in pre-national accounts GDP estimates.[238]

Real product series was complemented with a quantity index for investment based on construction and public works, afforestation and the consumption (production plus imports) of machinery and equipment.

V.3.2 *Schwartz*

A major attempt at overcoming CEN's estimates for the period 1940-1960 was carried out by Pedro Schwartz, at the Bank of Spain's research unit, where he assembled new empirical evidence and used transparent methods in which indirect methods and regression analysis were combined (Schwartz, 1976). In the new series, gross value added for every major sector in the economy was obtained by regressing their value added levels (derived from official national accounts) on a set of indicators over 1954-1960, and the resulting structural relationship was applied to the set of variables or indicators to compute sectoral value added for the earlier pre-national accounts period 1940-1953. Gross domestic product (nominal and real) was derived by aggregation.[239]

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[237] The first independent attempt to derive national income estimates on an yearly basis was carried out by José Castañeda (1945) who provided an estimate of national expenditure from a sample of indirect taxes and government's monopoly revenues, deflated by a wholesale price index, for the period 1901-1934.

[238] Each of the 26 groups of goods and services, defined according to the 1958 input-output table's (TIOE58) classification of economic activities, was constructed as a Laspeyres volume index with 1958 weighting. In ICE estimates the coverage of output was far superior to CEN's, with 227 and 45 basic series for industry and services. For agricultural output (excluding livestock, forestry and fishing, for which 21 basic new series were used), CEN revised index was adopted. Weights applied to agriculture, industry and services to derive the "general index of total production" were 0.2693, 0.3200 and 0.4107, respectively.

[239] An indicator is, according to Balke and Gordon (1989), a time-series variable that is correlated with real product in the time period when real GDP is known, i.e., the post-1954 years.

V.3.3 *Carreras*

The most ambitious attempt to derive historical series of real GDP was produced by Albert Carreras (1985) who built up an index from the demand side, covering a longer time span, 1849-1958.[240] Weights for the main aggregates (private and public consumption, investment, net exports) were derived from the 1958 benchmark from the National Accounts, while the 1958 Input-Output Table allowed the breakdown of each series into its main components.[241]

However, a few shortcomings can be observed in an otherwise major piece of research. For example, the consumption series only cover food, beverages and tobacco, and clothing while services are neglected.[242] Actually, it could be argued that consumption growth may be possibly biased downwards since the goods included in the series (food and clothing) are those of lower income elasticity of demand.[243] In addition, the use of end-year (1958) fixed weights could underestimate GDP growth since relative prices for capital goods, the fastest growing component of expenditure, declined over time rendering, hence, a lower weight for investment than would have been the case if relative prices of any previous year were used.[244]

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[240] The only precedent of Carreras' demand approach is CPD (1972), but it did not represent an independent estimate.

[241] Some objections can be raised to the use of a 1958 benchmark as it comes from a autarchic period in which prices were intervened by Government regulation and protection. This is a similar case to those of Italy's 1938 (Bardini, Carreras and Lains, 1995:123) and Germany's 1937 (Broadberry, 1997) benchmarks. It can be argued, however, that the 1958 Input-Output Table is not only the first one available but the most detailed Spanish one (207 sectors) to date.

[242] Food and clothing represent 70 per cent of total consumption in the benchmark year 1958 (CNE58). However, the sample of consumption goods used in the construction of the annual index only reaches a coverage of 20 per cent up to 1928, and 41 per cent thereafter, as measured for the 1958 benchmark (Carreras, 1985: 38-39, 45). Naredo (1991: 144) claimed that Carreras reliance on García Barbancho's (1960) food consumption data led him to use out-dated, downward biased agricultural output statistics.

[243] Income elasticity of demand for housing, durables, personal care, transport, recreation, etc. was significantly higher than for food and clothing in 1958 Spain (Lluch, 1969: 68, 78).

[244] Two other objections could also be raised to Carreras' pathbreaking contribution. Government consumption was deflated by a wholesale price index, and not by a consumer price index, a better suited deflator, as wages and salaries constituted its main component, since no comprehensive CPI was available at the time the paper was written. In addition, the trade balance only covers commodities. Carreras used official values for exports and imports that exagerate commodity trade deficit for most of the period up to 1913 (see section IV).

V.4 Comparing the New and Earlier GDP Estimates

How does the new GDP series compare to the earlier estimates? There is a significant agreement about performance over the long run between Carreras estimates and my new series, although significant discrepancies emerge in the short term. (Figure 21 and Table 12). During the first half of the twentieth century, the new GDP series present slower growth than those by Alcaide and CEN (Figure 22).

When the focus is placed on specific periods, the variance across different estimates emerges. World War I years seem to have been of fast growth (CEN, Alcaide, and Carreras), in which the economy would have taken advantage of Spain's neutrality to cater for the needs of beligerant nations while domestic industry expanded on the basis of import substitution. This conventional depiction is challenged by the new GDP series. Then, the post-war years and especially the 1920s exhibit accelerated growth in CEN and Alcaide's estimates while Carreras' suggest deceleration. The new GDP series provide an even more optimistic picture than Alcaide's.

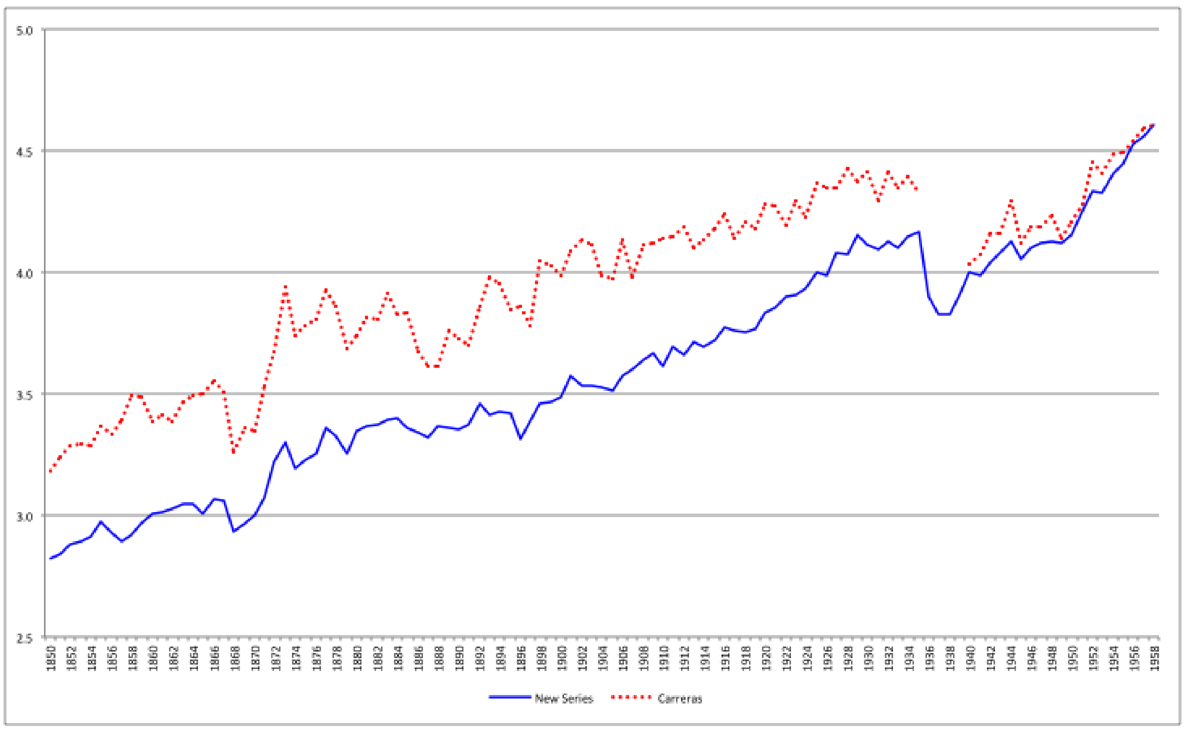

Figure 21, Alternative Real GDP Estimates, 1850-1958 (1958=100) (logs)

The impact of Great Depression in Spain (1929-1933) varies dramatically according to different authors. Spain's economy decelerated but continued growing in Alcaide's view, stagnated in Naredo's, mildly contracted in Carreras' computations, and definitely shrank in CEN's estimates. The new series side along CEN's but with a less intense decline.

Earlier estimates are discontinued between 1936 and 1939, so comparing output levels in 1935 and 1940 is the only way to assessing the impact of the Civil War. A consensus exists about a substantial contraction in economic activity during the war years, around 6 per cent per annum, but for Naredo's mild -2.1 per cent. In my new estimates, the Civil War represented a milder but still deeper shrinkage than Naredo's.[245]

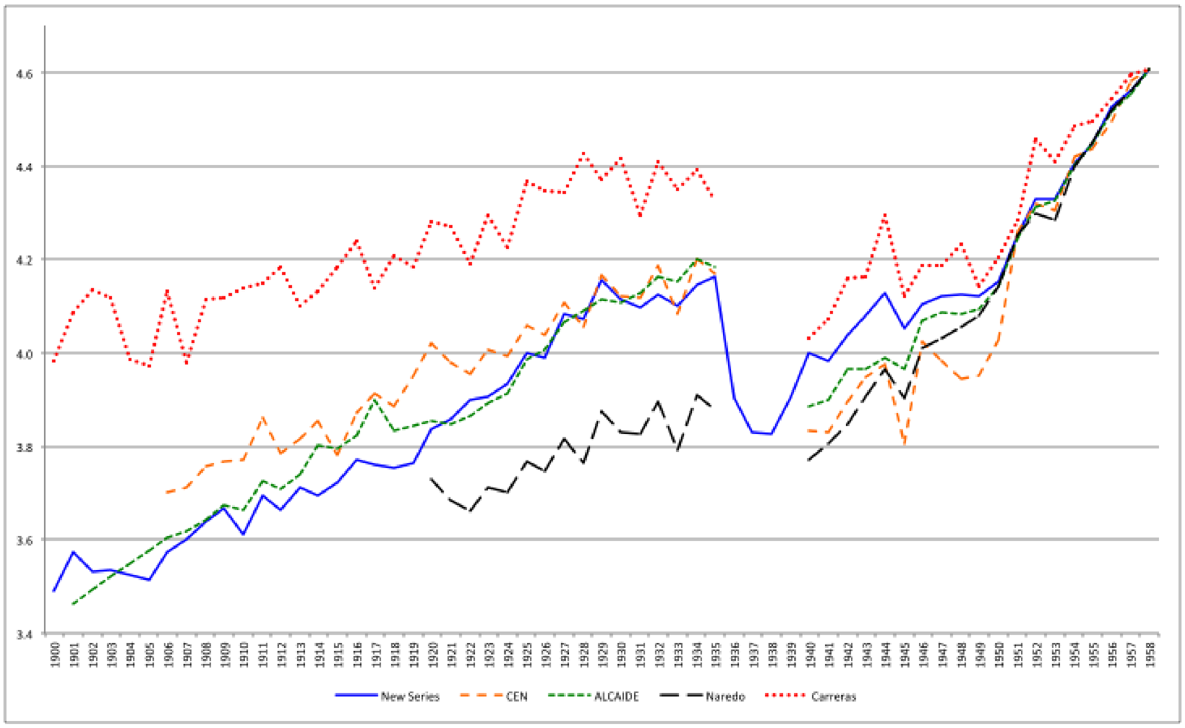

Figure 22, Alternative Real GDP Estimates, 1900-1958 (1958=100) (logs)

The postwar recovery was mild (but for Carreras and Naredo estimates) and short lived (CEN, Carreras, and Schwartz), and only resumed at a fast pace in the 1950s (except for Alcaide). The new GDP estimates concur with the view of a post-Civil War mild and

[245] Actually, my yearly estimates indicate a sharper decline between 1935 and 1938, at -11 per cent per year, followed by a recovery up to 1944.

long recovery, which makes Spanish post-war experience different from Western Europe's fast return to pre-war output levels (Maddison, 2010).

Table 12
Real GDP Growth in the Pre-National Accounts Era: Alternative Estimates, 1850-1958 (%)

	CEN	CPD	Alcaide	Naredo	ICE	Schwartz	Carreras	New Series
1850-1958							1.7	1.7
1901-1958	2.6		2.8				1.6	1.8
1850-1883							2.2	1.7
1883-1913							0.6	1.1
1901-1913	1.6		2.3				0.1	1.2
1913-1918	1.4		1.9				2.2	0.3
1918-1929	2.5		2.6	1.6			1.5	3.9
1929-1933	-2.1		1.0	-2.1			-0.6	-1.5
1933-1935	4.3		1.5	4.3			-1.1	3.0
1935-1940	-6.7		-6.0	-2.1			-5.9	-3.5
1940-1944	3.6	0.7	2.6	4.8		2.6	6.5	4.0
1944-1950	0.8	2.8	2.5	2.9		0.6	-1.5	0.2
1950-1958	7.2	6.2	5.8	5.8	5.1	6.0	5.0	5.8

Note: 'New Series' are GDP estimates at market prices.
Sources: New Series, see the text. CEN (1945, 1965), ICE (1962), CPD (1972), Alcaide (1976), Naredo (1991), Schwartz (1976), and Carrerras (1985).

VI. SPLICING NATIONAL ACCOUNTS, 1958-2015

National accounts rely on complete information on quantities and prices to compute GDP for a single benchmark year, which is, then, extrapolated forward on the basis of limited information for a sample of goods and services. To allow for changes in relative prices and, thus, to avoid that forward projections of the current benchmark become unrepresentative, national accountants periodically replace the current benchmark with a new and closer GDP benchmark. The new benchmark is constructed, in part, with different sources and computation methods.[246]

VI.1 National Accounts in Spain

In Spain's national accounts benchmarks for 1958 (CNE58) and 1964 (CNE64) were derived using OECD criteria, while the United Nations System of National Accounts (SNA) was used for all the rest (CNE70, CNE80, CNE86, CNE95, CNE00, CNE08, CNE10) (Table 13).[247] Detailed sets of quantities and prices (derived from the closest input-output table) were employed to compute GDP at the benchmark-year (1958, 1964, 1970, 1980, 1986, 1995, 2000, 2008, 2010).[248]

Differences in a new benchmark year between 'new' and 'old' national accounts stem from statistical (sources and estimation procedures) and conceptual (definitions and classifications) bases. Once a new benchmark has been introduced, newly available statistical evidence would not be taken on board to avoid a discontinuity in the existing series (Uriel, 1986: 69) so the the coverage of new economic activities lmay explain the discrepancy between the new and old series. Furthermore, discrepancies between 'new' and 'old' benchmarks for the year in which they overlap also stem from statistical (sources and estimation procedures) and conceptual (definitions and classifications) differences. As

[246] Improving the comprehensiveness, reliability and comparability of national accounts estimates through the use of new statistical sources, the inclusion of new concepts, and the adoption of new computation procedures, often due to the adoption of new or updated international standards, are the technical reasons provided by national statistical offices for their periodical revisions of national accounts' benchmarks and the resulting breaks in GDP time series.

[247] At the turn of the century the European System of Accounts (ESA) replaced the SNA, being SNA93 and ESA95 fully consistent. Series constructed with different benchmarks' prices and quantities are named after the year, e.g., CNE70, that is, *Contabilidad Nacional de España* (National Accounts of Spain) with 1970 as the base-year.

[248] For all these benchmark-years input-output tables are available, except for 1964 and 1986, for which the closest ones are those for 1962 and 1966, and 1985, respectively.

a result, the consistency between the new and old national account series breaks.

Table 13

Spain's National Accounts, 1954-2015

	Benchmark Year	Coverage
CNE58	1958	1954-1964
CNE64	1964	1964-1972
CNE70	1970	1964-1982
CNE80	1980	1970-1985
CNE86	1985/86	1964-1997
CNE95	1995	1995-2004
CNE00	2000	1995-2009
CNE08	2008	1995-2013
CNE10	2010	1995-2015

Note: Direct estimates only refer to years after the benchmark.
Sources: IEF (1969), INE (various years).

The obvious solution to this inconsistency problem would be *recompilation*, that is, computing GDP for the years covered by the old benchmark with the same sources and procedures employed in the construction of the new benchmark. However, national accountants do not follow such a painstaking option.

A simple solution, widely used by national accountants (and implicitly accepted in international comparisons), is the *retropolation* approach, in which the new series (Y^R) results from accepting the reference level provided by the most recent benchmark estimate (Y_T) and, then, re-scaling the earlier benchmark series (X_t) with the ratio between the new and the old series for the year (T) at which the two series overlap (Y_T/X_T).

$$Y^{R}{}_{t} = (Y_T / X_T) * X_t \qquad \text{for } 0 \leq t \leq T \qquad (15)$$

For example, in order to obtain CNE70 estimates for 1964-1969, Spanish national accountants projected backwards (*retropolated*) the new 1970 GDP level (CNE70) with the rates of variation derived from the old benchmark series (CNE64). The *retropolation* approach was also adopted to derive series levels for the years 1964-1979 in both the 1980 and the 1986 benchmarks (CNE80 and CNE86).[249]

[249] Such is the approach implicitly supported by Uriel (1986) and Uriel, Moltó, and Cucarella (2000). This procedure has the advantage of being less time consuming and not altering the yearly rates of variation resulting from the 'old' benchmark series.

The choice of the *retropolation* procedure was made on the arguable assumption that growth rates originally calculated could not be improved (Corrales and Taguas, 1991). Underlying this approach is the implicit assumption of an error level in the old benchmark's series whose relative size is constant over time. In other words, no error is assumed to exist in the old series' rates of variation that are, hence, retained in the spliced series $Y^R{}_t$(de la Fuente, 2014). Official national accountants have favoured this procedure of linking national accounts series on the grounds that it preserves the earlier benchmark's rates of variation.[250] The *retropolation* approach pays no regard to the unpredictable but significant effects of using a set of relative prices from the old benchmark to project the level of the new benchmark backwards.

Table 14

GDP at market prices: Alternative Estimates

(Million Euro at current prices)

	[I]	**[II]**	**[III]**	**[IV]**	**[V]**	**[VI]**	**[VII]**	**[VIII]**	**[IX]**	**[X]**	**[XI]**	**[XII]**	**[XIII]**	**[XIII]**	**[XIV]**
	CNE10	**CNE08**	**CNE00**	**CNE95**	**CNE86**	**CNE80**	**CNE70**	**CNE64**	**[(I)/(II)]**	**[(II)/(III)]**	**[(III)/(IV)]**	**[(IV)/(V)]**	**[(V)/(VI)]**	**[(VI)/(VII)]**	**[(VII)/(VIII)]**
1964					7265	7360	7225	**6543**					0.9871	1.0187	1.1042
1970					15806	15772	**15483**	13607					1.0021	1.0187	**1.1379**
1980					91161	**91409**	91264						0.9973	**1.0016**	
1986				175625	**194271**	192009						0.9040	**1.0118**		
1995	459337	446795	447205	**437787**	419387	413788			1.0281	0.9991	1.0215	**1.0439**	1.0135		
2000	646250	629907	**630263**	610541					1.0259	0.9994	**1.0323**				
2008	1116207	**1087788**	1088124						1.0261	**0.9997**					
2010	**1080913**	1045620							**1.0338**						

Sources: IEF (1969), INE (various years).

The main methodological discontinuity in Spanish national accounts occurred when the SNA substituted for the OECD method in the late 1970s. Table 14 provides the values of each benchmark series at base years and the ratio between each pair of adjacent 'new' and 'old' benchmark values. Substantial discrepancies are noticeable between CNE64 (constructed with OECD criteria) and CNE70 (derived with SNA criteria), benchmarks within a period of fast growth and deep structural change (Prados de la Escosura, 2007b).

[250] For the case of Spain, cf. Uriel (1986), Corrales and Taguas (1991), INE (1992), Uriel, Moltó and Cucarella (2000). In the Netherlands, a pioneer country in national accounts, it was only after the 1993 SNA classification that the *retropolation* method was challenged (den Bakker and van Rooijen, 1999).

It is worth noting that the most recent benchmark usually provides a higher GDP level for the overlapping year, as its coverage of economic activities is wider. Thus, the backwards projection of the new benchmark GDP level with the available growth rates - computed at the previous benchmark's relative prices- implies a systematic upwards revision of GDP levels for earlier years.[251] The evidence in Table 14 highlights the impact of successive one-side upwards revisions, which widens the gap over time. In fact, the GDP figure obtained by the cumulative re-scaling different national accounts sub-series from 2010 backwards (that is, using the r*etropolation* approach) is 28.4 per cent higher for 1970 than the one computed by CNE64 (and 24.6 per cent higher than the one directly calculated for 1964).[252]

Would it be reasonable to expect such an underestimate from a direct GDP calculation on the basis of 'complete' information about quantities and prices of the goods and services in the old benchmark? Can the direct measurement of GDP level at an early benchmark year be really improved through the backward projection of the latest benchmark-year with earlier benchmarks' annual rates of variation?

The challenge is to establish the extent to which conceptual and technical innovations in the new benchmark series hint at a measurement error in the old benchmark series. In particular, whether the discrepancy in the overlapping year between the new benchmark (in which GDP is estimated with 'complete' information) and the old benchmark series (in which reduced information on quantities and prices is used to project forward the 'complete' information estimate from its initial year) results from a measurement error in the old benchmark's initial year estimate, or it is the cumulative result of the emergence of new goods and services not considered in the old benchmark series.

[251] This linkage procedure helps to understand the one-sided upward revisions Boskin (2000) finds in US national accounts.

[252] This percentage increase for 1970 results from successively multiplying the ratios of adjacent benchmarks at overlapping years, that is, CNE10/CNE08 in 2010, CNE08/CNE00 in 2008, CNE00/CNE95 in 2000, CNE95/CNE86 in 1995, CNE85/CNE80 in 1985, CNE80/CNE70, in 1980, and CNE70/CNE64 in 1970, [1.0338*0.9997*1.0323*1.0439*1.0118*1.0016*1.1378 =1.2841]. If alternatively, CNE10/CNE00 in 2010 is used, the results alters slightly [1.0254*1.0323*1.0439*1.0118*1.0016*1.1378 =1.2741] (See Table 14).

An alternative to the *retropolation* method is provided by the *interpolation* procedure that accepts the levels computed directly for each benchmark-year as the best possible estimates -on the grounds that they have been obtained with 'complete' information on quantities and prices-, and distributes the gap or difference between the 'new 'and 'old' benchmark series in the overlapping year T at a constant rate over the time span in between the old and new benchmark years.[253]

$$Y^{I}_{t} = Y_{t} * [(Y_{T} / X_{T})^{1/n}]^{t} \qquad \text{for } 0 \leq t \leq T \qquad (16)$$

Being Y^{I} the linearly *interpolated* new series, Y e X the values pertaining to GDP according to the new and old benchmarks, respectively; t, the year considered; T, the overlapping year between the old and new benchmarks' series; and n, the number of years in between the old (0) and the new benchmark (T) dates.[254]

Contrary to the *retropolation* approach, the *interpolation* procedure assumes that the error is generated between the years 0 and T. Consequently, it modifies the annual rate of variation between benchmarks (usually upwards) while keeps unaltered the initial level –that of the old benchmark-. As a result, the initial level will be probably lower than the one derived from the *retropolation* approach.

In Spanish national accounts a break in the linkage of GDP series through *retropolation* was introduced in CNE86, when national accounts were spliced using the *interpolation* approach and the GDP differential between CEN86 and CEN80 in 1985 was distributed at a constant rate over the years 1981-1984 (expression 16) (INE, 1992). However, a new national accounts benchmark in 1995 (CNE95) did not bring along a splicing of CNE95 and CNE86 series.[255] In later benchmarks (CNE00, CNE08, and CNE10) the *interpolation* method was resumed, but only after adjusting upwards the old

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[253] Maddison (1991) presented the first methodological discussion along these lines and spliced GDP series through *interpolation* for the case of Italy.

[254] An alternative to the linear interpolation is a non-linear one, in which the gap between the new and old series at the overlapping year is distributed over the old series at a growing, rather than at a constant, rate. However, there are hardly any significant discrepancies between the linearly and non-linearly interpolated series (Prados de la Escosura, 2016). Therefore, in order to keep consistency with the official national accounts from 1995 onwards and facilitate updating insuccesive years I have chosen to use the linear interpolation.

[255] The National Statistical institute (INE) never produced a new spliced series of the latest base-year CNE00 back to 1964, 1970, or 1980. The Quarterly National Accounts provided spliced series from 1980 onwards but without a detailed explanation of the splicing procedure.

benchmark for methodological changes.[256] Thus, the gap between, say, CNE10 and CNE00-08 in the year 2010, was decomposed into methodological and statistical plus other differences.[257] Firstly, CNE00-08 series for 1995-2009 were adjusted upwards for methodological discrepancies with CNE10. Then, the *residual* gap, due to statistical and other differences, was distributed at a constant rate (using expression 16) over the in-between benchmarks years, 2001-2009.[258] As a result no officially spliced GDP series are available at the present for the entire national accounts era.

VI.II Splicing National Accounts through Interpolation

A straightforward procedure would be, then, splicing the all benchmark series available by accepting the levels directly computed for each benchmark year and distributing the gap between each pair of adjacent benchmark series at their overlapping year at either a constant rate over the time span between them. This solution has the advantage of being transparent and linking different benchmarks equally.

Nonetheless, before computing and comparing alternative splicing results, pre-1980 national accounts need to be examined because, as mentioned earlier, it is during the transition between OECD and SNA methodologies when larger disparities between adjacent benchmarks series emerged in overlapping years. By examining the way OECD (CNE64) and SNA (CNE70) benchmarks were constructed an attempt to reconcile their differences can be made.

In pre-1980 official national accounts, annual nominal series of, say, industrial value added were usually obtained through back and forth extrapolation of the benchmark year's gross value added with an index of industrial production that was, then, reflated with a price index for industrial goods. Projecting industrial real value added with

[256] No mention of any methodological adjustment was made in the splicing through interpolation of CNE80 and CNE86.

[257] It should be noted that since there were minor methodological and statistical changes between CNE00 and CNE08, the major revision embodied in CNE10 led to a new interpolation between CNE00-CNE08 and CNE10 that was extended over the years 1995-2009.

[258] The same procedure was applied to the gap between CNE00 and CNE95 in 2000, and CNE08 and CNE00 in 2008, with the statistical gap distributed over the intermediate years 1996-1999, and 2001-2007, respectively. The Spanish Statistical Institute notes, "The [remaining] differences between both estimates [CNE00 and CNE95 in the year 2000] are due to the statistical changes, and given that information is not available regarding how and at what time they have been generated, it is assumed that this has occurred progressively over time, from the beginning of the previous base" (INE, 2007: 5).

an index of industrial production amounts to a single deflation of value added, in which the same price index is used for both output and inputs.[259] However, only if prices for output and intermediate inputs evolve in the same direction and with the same intensity, real value added is accurately represented by an industrial production index. In periods of rapid technological change (or external input price shocks) significant savings of intermediate inputs do take place while relative prices change dramatically, and, hence, the assumption of a parallel evolution of output and input prices does not hold.[260] This description applies well to Spain in the 1960s and 1970s, when the country opened up to foreign technology and competition and suffered the oil shocks.[261] Fortunately, alternative estimates of gross value added at constant prices derived through the Laspeyres double deflation method[262] are available for industry and construction over the years 1964-1980 (Gandoy, 1988).[263] Gandoy's value added series exhibit higher real growth rates than CEN70 series since her implicit value added deflator grows less than the national accounts' deflator (biased towards raw materials and semi-manufactures).[264] This is what should be expected in a context of total factor productivity growth, such as was the case of Spain in

[259] Cf. Cassing (1996) for a discussion of alternative deflation procedures. See, alternatively, David (1962) and Fenoaltea (1976) for a defence of single deflation as a way of avoiding negative values of real value added.
[260] In the dual approach to computing total factor productivity (TFP), over time changes in TFP are measured as the differential between the rate of variation of the output price and that of weighted input prices. In other words, a faster decline (less marked increase) of output prices than of inputs prices, due to input savings, reflects TFP growth.
[261] The 1950s, especially since 1953, were years of rapid growth and structural change in which double deflation would make a difference over single deflation. Unfortunately lack of data prevents this option.
[262] By double deflation is meant that real gross value added is obtained as the difference between output at constant prices and intermediate consumption at constant prices, that is, each of them independently deflated with their own price indices. For a theoretical discussion of double deflation, cf. David (1962), Sims (1969), Arrow (1974) and Hansen (1975).
[263] Cf. also Gandoy and Gómez Villegas (1988). Occasionally, when strong discrepancies between output and inputs prices were observed, and data availability allowed it, CNE70 used double deflation but, in any case, never over the years 1978-1981. In the case of agriculture, real value added was properly assessed in CNE70, as the purchases of industrial and service inputs represented a small share of final output. As for services, the difficulties to produce double deflated value added series, comparable to those for agriculture and manufacturing, persisted over time.
[264] Cf. Krantz (1994).

the 1960s and early 1970s, with output prices growing less than inputs prices, as inputs savings resulted from efficiency gains (Prados de la Escosura and Rosés, 2009).[265]

Thus, CEN70 series for GDP have been revised for 1964-1980. Firstly, Gandoy (1988) alternative value added estimates for industry and construction (GVA^G_i and GVA^G_c) were substituted for those in official national accounts (GVA^{cen70}_i and GVA^{cen70}_c).[266] CNE70 value added figures for agriculture (GVA^{cen70}_a) and services (GVA^{cen70}_s) were kept.[267] Total Gross Value Added was reached by adding up sectors' gross value added.

$$GVA^T = GVA^{cen70}_a + GVA^G_i + GVA^G_c + GVA^{cen70}_s \qquad (17)$$

GDP at market prices was derived, in turn, by adding taxes on products net of subsidies to total gross value added.

CEN70 GDP estimates on the expenditure side were also adjusted. While Gandoy (1988) provides alternative value added series at factor cost for industry ($VA_{fc}{}^G{}_i$) and construction ($VA_{fc}{}^G{}_c$), Gómez Villegas (1988) presents new series for fixed domestic capital formation in industry (GCF^G_i) and construction (GCF^G_c). Thus, in order to adjust the aggregate figure for investment in CNE70 (GCF^{cen70}), I firstly computed the share of value added at market prices (VA_{mp}) allocated to investment in industry and construction, according to Gandoy (1988) and Gómez Villegas (1988), ($GCF^G_i / VA_{mp}{}^G{}_i$ and $GCF^G_c / VA_{mp}{}^G{}_c$), which implied adjusting value added to include taxes on production and imports net of subsidies.[268] Then, I applied this share to the difference between the value added estimates at factor cost in Gandoy's ($VA_{fc}{}^G{}_i$ and $VA_{fc}{}^G{}_c$) and in CEN70 ($VA_{fc}{}^{cen70}{}_i$ and $VA_{fc}{}^{cen70}{}_c$).

$$GCF^{add}_i = (GCF^{Gi} / VA_{mp}{}^G{}_i) * (VA_{fc}{}^G{}_i - VA_{fc}{}^{cen70}{}_i) \qquad (18)$$

$$GCF^{add}_c = (GCF^G_c / VA_{mp}{}^G{}_c) * (VA_{fc}{}^G{}_c - VA_{fc}{}^{cen70}{}_c) \qquad (19)$$

[265] Although, fortunately, from 1980 onwards, CNE80 provided industrial value added computed through the standard double deflation procedure, double-deflated value added figures for construction and services were still problematic. Cf. INE (1986) for a discussion of CNE80.

[266] Also van Ark (1995) chose Gandoy (1988) series over the original national accounts. Among van Ark's reasons are the downward bias in the growth rates of industrial production indices and its failure to adjust to the emergence of new products and quality changes.

[267] For the reasons to keeping original CNE70 gross value added for agriculture and services see footnote 281. For a discussion of the problems in measuring services' gross value added through double deflation, see Mohr (1992).

[268] In practical terms, the adjusted was carried out with the ratio between GDP at market prices and factor cost.

So the additional investment –that is, the portion of gross capital formation not included in CNE70- was obtained. Thus,

$$GCF^{add} = GCF^{add}_{i} + GCF^{add}_{c} \qquad (20)$$

And the revised figure for gross capital formation was derived as,

$$GCF^{1970R} = GCF^{cen70} + GCF^{add} \qquad (21)$$

Then, I adjusted private consumption figures in CEN70 for the changes introduced in gross capital formation. That is, I assumed that the additional value added in industry and construction (derived by deducting CNE70 value added from Gandoy's estimates) less the additional investment (GCF^{add}) accrued to private consumption, since the values for net exports of goods and services (NX^{cen70}) and public consumption ($GOVT^{cen70}$) provided by CEN70 were obtained from a sound statistical basis.[269] That is,

$$CONS^{add} = ((VA_{fc}{}^{G}_{i} + VA_{fc}{}^{G}_{c}) - (VA_{fc}{}^{cen70}{}_{i} + VA_{fc}{}^{cen70}{}_{c})) - GCF^{add} \qquad (22)$$

And the revised figure for total private consumption was reached as,

$$CONS^{1970R} = CONS^{cen70} + CONS^{add} \qquad (23)$$

Lastly, the new estimates of GDP at market prices were obtained as,

$$GDP^{1970R}_{mp} = CONS^{1970R} + GCF^{1970R} + GOVT^{cen70} + NX^{cen70} \qquad (24)$$

How are interpolated, then, earlier, pre-1980, national account benchmark series? CNE70^R series have been accepted for the years 1964-1969, rather than distributing the difference in 1970 between CNE70^R and CNE64 over these years. The reason of this choice is that CNE70^R series have been mainly derived through double deflation, as opposed to CNE64 single deflation series. CNE70^R and CNE58 series were, in turn, interpolated by distributing their gap in 1964 over 1959-1963.[270] Lastly, in order to I derived a single series for GDP and its components for the pre- and post-1980 series, I distributed their gap in the overlapping year, 1980, over 1971-1979. Aggregated GDP figures result from adding up its previously spliced components.[271]

[269] Actually, $CONS^{add}$ equals the differential between the revised GDP estimates (GDP^{r}_{mp}) and CNE70 GDP (GDP^{cen70}_{mp}) plus the estimated additional investment (GCF^{add}).

[270] There is no discrepancy between CNE58 and CNE64 estimates at their overlapping year, 1964. It is worth noting that in absence of double deflation in CNE58, splicing through interpolation provides a correction of its series that somehow amounts to an allowance for efficiency gains.

[271] It is worth mentioning that the resulting discrepancies between obtaining GDP through aggregation of its spliced components and splicing GDP directly are negligible. Thus, additive congruence has not been

This strict *interpolation* procedure has, nonetheless, the shortcoming of deviating from official national accounts series for the years 1995-2009. The reason is that, as observed above, in post-2000 Spanish national accounts its splicing is performed in two stages: firstly, the old benchmark series are adjusted upwards for methodological changes in the new benchmark; and, then, the remaining statistical gap is distributed at a constant rate over the years between the new and the old benchmarks.

Thus, an alternative to deriving GDP series through strict *interpolation* appears; namely, accepting the official *interpolation* linkage for 1995-2010 and interpolating the different benchmark (CNE58 to CNE95) series for the previous years, 1958-1995.[272]

It is worth noting, however, that, in CNE10 series, the GDP level for 1995 is higher (4.9 per cent) than the one originally computed with complete information in CNE95 (Table 14). What share of this gap is attributable to methodological differences? The CNE10 linkage procedure consisted in adjusting the CNE00 series for methodological differences back to 1995 and, then, distributing the remaining, mostly statistical, gap over 2001-2009, under the assumption that no statistical error exists in 2000. Thus, the entire discrepancy in 1995 between CNE10 and CNE95 could be attributable to methodological differences.[273] Should pre-1995 series, resulting from splicing all previous benchmarks (CNE58-CNE95), be raised, then, by a fixed ratio (1.0492)? This option does not seem reasonable, as it can be conjectured that the impact of methodological changes would be larger the closer the year's estimate to CNE10 benchmark year, 2010. A compromise solution would be to distribute the entire gap over the 1954-1994 series. Therefore, I have spliced the pre- and post-1995 series through a 'hybrid' *interpolation*, with an adjustment for methodological differences as described above.

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imposed. By additive congruence is meant that the addition of the different components of a given magnitude (output or expenditure) must be equal to its aggregate value (GDP). This is obtained by distributing, proportionally to their relative weight, the deviations of the addition of the linked components' values from the aggregate magnitude (Cf. Corrales and Taguas, 1991). This is implicitly done, however, for each of the sub-components of GDP components.

[272] As mentioned above, for the years 1980-1986, CNE86 provides spliced series derived from interpolating CNE86 and CNE80.

[273] Unfortunately, national accounts explanatory notes do not address this issue.

Figure 23 presents the ratio between the figures for nominal GDP obtained by splicing national accounts through 'hybrid' linear *interpolation* and those derived through *extrapolation*. It can be observed how the over-exaggeration of GDP levels derived through *retropolation* cumulates as one goes back in time, reaching around one-fifth by the late-1950s.

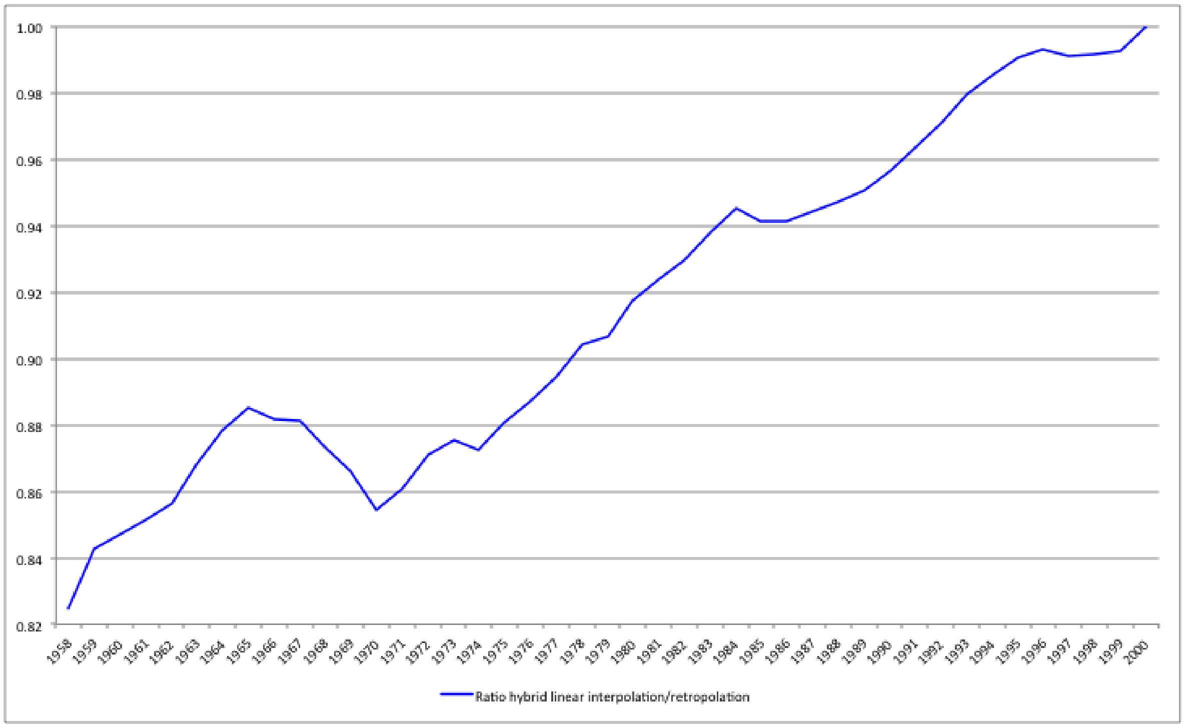

Figure 23. Ratio between Hybrid Linearly Interpolated and Retropolated Nominal GDP Series, 1958-2000
Sources: See the text.

Once GDP series at current prices were obtained, the next task was to deflate them in order to obtain GDP volume indices. Deflators for each CNE benchmark GDP series were also spliced through 'hybrid' linear *interpolation* as well as through *retropolation*. Interestingly, deflators derived through alternative splicing methods do not exhibit the far from negligible differences observed for current values.

Figure 24 presents the evolution of GDP at constant prices, expressed in log form, using alternatively the interpolated and retropolated series over 1958-2000. It can be observed that their differential widens significantly over time suggesting lower levels and faster growth for GDP estimates derived through interpolation.[274]

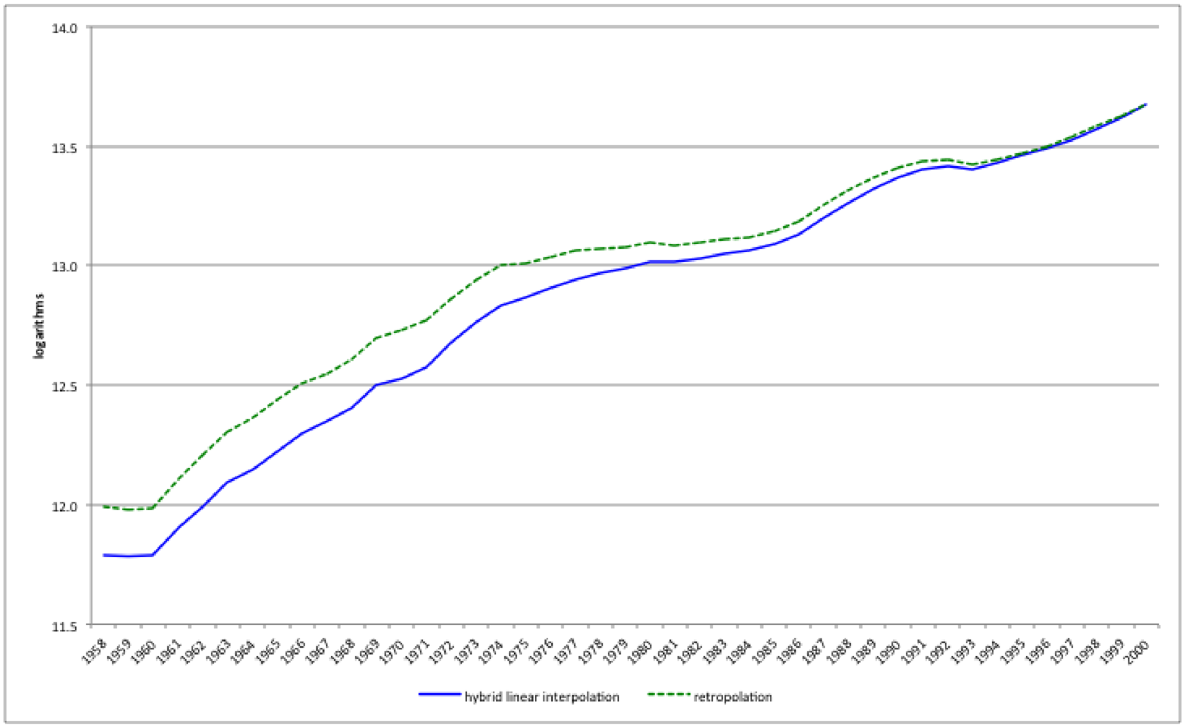

Figure 24 Real GDP, 1958-2000 (2010 Euro) (logs): Alternative Estimates with Hybrid Linear Interpolation and Retropolation Splicing (logs)
Sources: See the text.

Table 15
Real GDP Growth: Alternative Splicing, 1958-2010
(annual average rates %)

	hybrid linear interpolation	**retropolation**
1958-1964	5.9	6.2
1964-1970	6.4	6.2
1970-1980	4.9	3.7
1980-1986	1.9	1.5
1986-1995	3.7	3.2
1995-2000	4.1	4.0
2000-2010	2.2	2.2

Table 15 compares the resulting GDP growth rates between National Accounts benchmark years derived by splicing national accounts alternatively with ‘hybrid’ linear

[274] The following discussion applies to all estimates derived through the retropolation approach, including Uriel et al. (2000) and Maluquer de Motes (2008a, 2016), who erroneously uses the CPI as an alternative to the GDP implicit deflator. See my discussion of Maluquer de Motes estimates (Prados de la Escosura, 2009).

interpolation and retropolation approaches. GDP estimates derived through the interpolation procedure cast higher growth rates over the entire time span considered than those estimates resulting from the conventional retropolation method. The annual cumulative rate per person over 1958-2000 is 4.5 per cent compared to a 4.0 per cent for the retropolated series, respectively. The main discrepancies correspond to period 1970-1995, and particularly during the 1970s, in which the interpolated series exhibit a more than one-third faster growth rate. The implication is that, in the period of rapid expansion 1958-1974, Spain's delayed Golden Age, and, again, between Spain's accession to the European Union (1985) and the eve of the Great Recession (2007), the interpolated series grew faster that the retropolated ones. However, it is during the so-called 'transition to democracy' period (1974-1984), when the positive growth differential between the interpolated and the retropolated series reached its peak, (2.3 and 1.3 per cent, respectively). As a result, the deceleration following the exceptional growth of Spain's delayed Golden Age was less dramatic than suggested by conventional narrative. It is worth comparing the results to another alternative to the retropolation procedure provided by the 'mixed splicing', in which Ángel de la Fuente (2014, 2016) proposes an intermediate position in which an initial error in the old series, stemming from the insufficient coverage of emerging economic sectors, grows at an increasing rate. Unfortunately, the correction to the growth rate of the original series implies an arbitrary assumption about its size (See the discussion in Prados de la Escosura, 2016b).

Since de la Fuente (2016) favours Gross Value Added (GVA, equivalent to GDP at basic prices) the comparison is carried out in terms of real GVA (Figure 25). It can be observed that the results from 'mixed splicing' are not far apart from those I obtained through hybrid linear interpolation. Discrepancies only appear in the pre-1980 period for which de la Fuente (2016) linked his series to Uriel et al. (2000) GDP series spliced through retropolation.

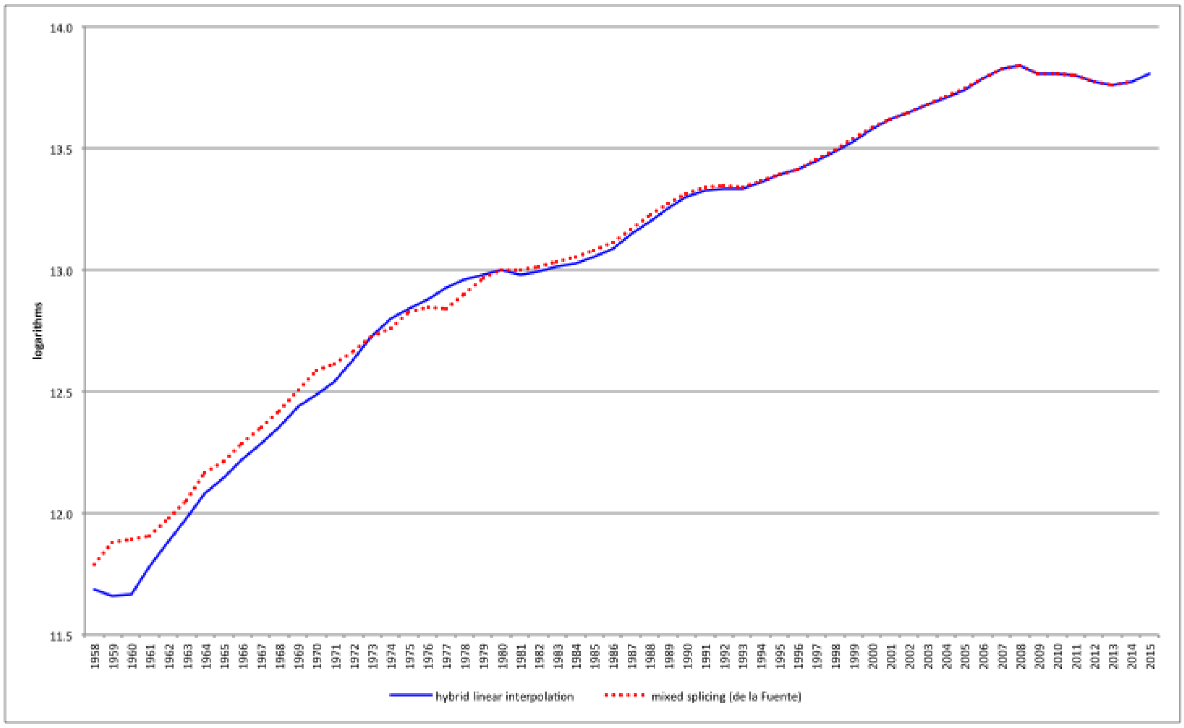

Figure 25 Real Gross Value Added, 1958-2015 (2010 Euro) (logs): Alternative Estimates with Hybrid Linear Interpolation and Mixed Splicing, 1958-2015.
Sources: Hybrid Linear Interpolation, see the text; Mixed Splicing, de la Fuente (2016).

VII. POPULATION, 1850-2015

Spain's Statistical Office (Instituto Nacional de Estadística, INE) provides yearly series of 'resident' population from 1971. INE also presents annual series of 'de facto' population for 1900-1991, in which figures for census benchmark years are linearly interpolated. Roser Nicolau (2005) collected and completed the series back to 1858. More recently, Jordi Maluquer de Motes (2008b) has constructed yearly estimates of 'de facto' population for 1850-1991 and spliced them with 'resident' population for 2001. In order to do so, Maluquer de Motes started from census figures at the beginning of each census year adding up annually the natural increase in population (that is, births less deaths) plus net migration (namely, immigrants less emigrants). I have followed Maluquer de Motes's approach with some modifications. Thus, I have accepted census benchmark years' figures and Gustav Sündbarg (1908) estimate for 1850, and obtained the natural increase in population with Nicolau (2005) figures for births and deaths from 1858 onwards, completed for 1850-1857 with Sündbarg (1908) net estimates at decadal averages equally distributed.[275] My main departure from Maluquer de Motes approach has been with regards to net migration for which I have accepted Blanca Sánchez-Alonso (1995) estimates for 1882-1930, completed back to 1850 and forth to 1935 with statistical evidence from Spanish and main destination countries' sources (see section IV.3.4). For the years of the Civil War (1936-1939) and its aftermath (1940-1944) I have accepted José Antonio Ortega and Javier Silvestre (2006) gross emigration estimates for 1936-1939, assuming no immigration during the war years, and distributing evenly an upward revision of their return migration estimates for 1940-1944, while assuming no gross emigration during World War II.[276] In order to obtain a consistent series for 1850-1970 I have spliced population estimates linearly by distributing the difference between the estimated

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[275] Sündbarg (1908) estimates are reproduced in Maluquer de Motes (2008b: 145). I have used the average birth and death rates in 1858-1860 for the years 1850-1857, except in the case of 1855-1856 for which the death rate (45 per 1000) estimated for 1855 as a consequence of cholera epidemics by Pérez Moreda (1980: 398) has been used. I have also used the average of birth and death rates in 1870 and 1878-1880 for the years 1871-1877 in which data on total births and deaths are missing.

[276] Ortega and Silvestre (2006) consider the 162,000 net migration figure during 1940-1944 grossly underestimated. Pérez Moreda (1988: 418) reckoned a maximum permanent exile of non more than 190,000 people, a figure below the 200,000 provided by Tusell (1999) and much lower than a post-Civil War exile estimate (300,000) (Tamames, 1973). I have accepted Pérez Moreda's conjecture.

population obtained by forward projection of the initial census benchmark figure for the year of the next census benchmark, and the observed figure at the new census using expression (16). Lastly I have linked the linearly interpolated series for 'de facto' population for 1850-1970 with the 'resident' population series from 1971 onwards to get a single series.[277] Fortunately, the difference between the 'de facto' and 'resident' series over 1971-1991 is negligible.[278]

[277] Choosing 'resident' over 'de facto' population allows me to keep consistency with Spanish official national accounts, which employ 'resident' population.
[278] The average ratio between the resident and de facto population over 1971-1991 is 0.9956 with a coefficient of variation of 0.0048.

VIII. EMPLOYMENT, 1850-2015

The latest round of national accounts (CNE10) provides data on the number of full-time equivalent (FTE) workers and hours worked and its distribution by industry from 1995 to 2015. Unfortunately, no similar data are provided in earlier rounds of national accounts that present only figures for the number of occupied back to 1980 (CNE80 and CNE86). However, the 1995-based quarterly national accounts (CNTR95) provide data on FTE workers for 1980-1995. I have, then, spliced the two sets of FTE workers through linear interpolation to get consistent estimates over 1980-2015.[279]

For the pre-1980 years, García Perea and Gómez (1994) provide estimates of employment back to 1964 that can be pushed further back to 1954 with the rate of variation of employment provided in earlier national accounts (CNE64) (Instituto de Estudios Fiscales, 1969: 33-34). I have assumed that the number of FTE workers evolved alongside employment and, thus, projected its 1980 level backwards to 1954 with the employment rate of variation to derive FTE employment series for the period 1954-2015 for the economy as a whole and its main economic sectors.

The next challenge was to link the post-1954 series with the historical evidence back to 1850. Thus, on the basis of population censuses I constructed yearly employment estimates for 1850-1954 for the four main sectors: agriculture, forestry, and fishing; industry, mining, and utilities; construction; and services. Major shortcomings appear in Spanish census data: working population is only available at benchmark years and refers to the economically active population [EAN, thereafter], with no regard of involuntary unemployment.[280] Moreover, censuses tend to only record one activity per person, that which individuals consider being their principal activity, and this tends to be 'farmer'. However, in a developing society the division of labour is low and a single person might

[279] The CN10/CNTR95 ratio in the overlapping year, 1995, is 1.02 for total FTE workers and 0.99, 0.93, 1.00, and 1.04 for full-time equivalent workers employed in agriculture, industry, construction, and services, respectively. See Section VI.1 and, in particular, expression (16) for the linear interpolation procedure used.
[280] Nevertheless, in a predominantly agricultural economy such as that of Spain up to the 1950s, modern unemployment in the modern sense of the word was quite reduced, save during exceptional crises. Still, there was a lot of seasonal as well as hidden unemployment in the agricultural sector (labour hoarding) (Pérez Moreda, 1999: 57).

undertake various work tasks over the course of a year.[281] Henceforth, activities corresponding to the industrial and, particularly, service sectors end up being underestimated in population censuses.[282] In addition, figures for female EAN in agriculture seem to be inconsistent over time.[283] Therefore, I have been forced to make some choices. For example, in order to derive consistent figures over time for EAN in agriculture, I excluded the census figures for female population, while assumed that female labor represented a stable proportion of male labor force in agriculture and, hence, increased the number of days assigned to each male worker (see below).[284] Moreover, as the share of EAN in agriculture is suspiciously stable over 1797-1910, in spite of industrialization and urbanization, I corrected it by assuming that the agricultural share of EAN moved along, and could not exceed, the proportion of rural population (living in towns with less than 5,000 inhabitants) in total population.[285] Thus, I adjusted downwards the percentage of EAN employed in agriculture between 1887 and 1920 by redistributing 'excess' agricultural

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[281] Moreover, as the opportunity cost of allocating agricultural labour to alternative occupations during the slack season was minimal, peasants carried out additional non-agricultural activities, such as producing their own implements, clothing and providing services such as transportation and storing, and working in construction industry.

[282] The time of year in which census data was collected will also affect the very definition of one's occupation. If, for example, a census is conducted during the harvest season, results for agricultural employment include all those persons temporarily employed in agriculture, despite the fact that their principal occupation during the rest of the year may be in a separate sector.

[283] Female labour was not included in agricultural EAN in the 1797 and 1860 population censuses and represented a small and declining proportion of male labour, thereafter. Thus, female/male ratios in agricultural EAN were, according to population censuses around 0.2 over 1877-1900 and ranged between 0.05 and 0.1 during the first half of twentieth century (Nicolau, 2005).

[284] The exclusion of females working in agriculture from the total working population is usual in Spanish historical literature (Nicolau, 2005; Erdozáin and Mikelarena, 1999; Pérez Moreda, 1999: 55). Carré *et al*. (1975: 89) followed a similar strategy to one proposed here for the French case.

[285] Pre-1930 figures for rural population come from Gómez Mendoza and Luna Rodrigo (1986) and EAN from Pérez Moreda (1999), for 1860 and 1877, and Nicolau (2005), thereafter. Not everyone living in rural districts worked in agriculture, as some proportion, however small it might be, must have been employed in the provision of services and processed goods. It is often alleged that, at least in the south of the Iberian peninsula, there were agglomerations of fairly expansive populations that had no urban characteristics until the mid-1900s, as their inhabitants continued to carry out agricultural tasks. However, in these population centres a significant portion of the working population provided services and non-agricultural goods to the rest of the inhabitants. Thus, I have made the reasonable conjecture that those persons employed in agriculture but living in urban centres would tend to balance out with the population of industrial and service-sector workers living in rural population centers. Moreover, as income levels increase, both the rural population and the overall population of agricultural workers will decrease, although the latter does so at a faster rate, as there always exists some part of the population that opts to live in the countryside despite not being employed primarily in either agriculture or the raising of livestock (Prados de la Escosura, 2007a).

workers proportionally between industry, construction, and services.[286] The next step was to obtain yearly EAN figures through log-linear interpolation of benchmark observations. Since the resulting estimates do not capture yearly fluctuations in economically active population, a partial solution has been, firstly, to compute EAN share in working age population (WAN) and WAN share in total population (N), being WAN and N computed through linear interpolation (^{i}) between population censuses.[287] Then, these ratios have been multiplied by the new yearly population estimates (N) to derive annual figures of economically active population (EAP). Thus,

$$EAP = (EAP^{i}/WAN^{i})\ (WAN^{i}/N^{i})\ N \qquad (25)$$

Later, in order to adjust for differences in labour intensity across main economic sectors and obtain a crude measure of full-time equivalent worker by industry, the data on EAP was converted into days worked per year. I assumed that each full-time worker was employed 270 days per annum in industry, construction, and services. Such figure results from deducting Sundays and religious holidays plus an allowance for illness. This assumption is in line with contemporary testimonies and supported by the available evidence.[288] In agriculture, however, contemporary and historians' estimates point to a lower figure for the working days per occupied, as full employment among peasants only occurred during the summer and, consequently, workers were idle for up to four months every year. It can be assumed that the working load per year for the average male worker in agriculture would range, at most, between 210 and 240 days.[289] However, in order to make for the exclusion of female employment in agriculture (due to the absence of

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[286] Thus, the percentage share of agriculture in EAN for 1887 (65.3), 1900 (66.3), 1910 (66.0) and 1920 (57.2) became 62.7, 60.75, 58.0, and 54.5 per cent, respectively. Original shares come from Nicolau (2005).

[287] Yearly estimates of population aged 15-64 for 1858-1960 were derived through interpolation between age cohorts at census benchmarks by David Reher, who kindly supply them to me. I extended the estimates back to 1850.

[288] Soto Carmona (1989: 608) pointed out that, on average, the number of days worked per occupied up to 1919 ranged between 240 and 270. Vandellós (1925) reckoned that, in 1914, the average number of days worked per year in mining was 250.

[289] Gómez Mendoza (1982: 101) emphasized the seasonal nature of late nineteenth century employment and estimated that, on average, a farm labourer worked 210 days out of 275-300 working days per year. This figure is not far from Bairoch (1965) estimate of 196 days for nineteenth-century Europe. Simpson (1992b) obtained even a lower figure (108 to 130 days per worker-year) from labour requirements in Andalusia's agriculture between 1886 and 1930. García Sanz (1979-80: 63) provided a higher figure, 242 days per year, for day labourers in mid-nineteenth century Spain.

consistent data), I increased the number of days assigned to male workers employed in agriculture to match the figure used for the rest of economic sectors (270).[290]

Lastly, figures for full-time equivalent employment by economic sector for 1850-1953 were derived by assuming that their yearly changes mirrored those in economically active population and, thus, FTE employment estimates for 1954 were backwards projected with those for economically active population (EAN). Total FTE employment for 1850-1954 resulted from adding up figures for sectoral estimates. It is worth noting that, in 1954, the ratio between FTE employment and EAN for each economic sector is 1.003 (agriculture), 0.872 (industry), 1.095 (construction), and 1.069 (services), and 1.000, for the aggregate. The implication, in the case of agriculture, is that, the upper bound figure for male employment (resulting from an attempt to make for missing female labour figures) matches that of full-time equivalent total employment (including female work).

The final step has been to derive hours worked in which I draw on Prados de la Escosura and Rosés (2010b: 526). For mid-nineteenth century agriculture, Caballero (1864) estimated 10 hours per day and a similar average figure, 9.7 hours, was found for the mid-1950s.[291] Thus, I accepted 10 hours per day for 1850-1911, interpolated these two figures over 1912-1935, and retained 9.7 hours for the period 1936-1954. For industry and services, I interpolated Huberman's (2005) figures for 1870-1899 to derive annual hours worked, and the number of hours worked in 1870 was accepted for 1850-1869. I adopted Domenech's (2007) estimates for different industries and services in 1910 for 1900-1910, and Silvestre's (2003) annual computations for industry for 1911-1919. As regard the interwar years, Soto Carmona (1989: 596-613) provides some construction and services figures. Data on hours worked for the early 1950s are often close to those of 1919. I accepted the number of working hours per occupied in 1954 for the years 1936-53, and interpolated the figures for 1919 and 1936. For the post-1954 period, hours worked for each branch of economic activity derive from Sanchis (private communication) for the

[290] The implication is that the assumed female/male ratio, in equivalent work effort, would range between 0.125 and 0.286, depending on whether male employees in agriculture are assumed to work 240 or 210 days per year, respectively.

[291] The figure for the 1950s was obtained by dividing the figure for yearly hours, which was kindly provided by Teresa Sanchis (private communication), by the number of working days per year.

1950s, Maluquer de Motes and Llonch (2005) for 1958-1963, Ministerio de Trabajo (1964-78) for 1964-1978, and OECD (2006) for 1979-1994. From 1995 onwards, the latest round of national accounts (CNE10) provides annual figures of hours worked. The resulting estimates show that the amount of total hours worked increased moderately, multipliplying by 2.1 over the 166 years considered, but falling short of the increase in population, that multiplied by 3.1.

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Appendix 1. Final Output and Gross Value Added in Agriculture, 1850-1958

Table A1.1
Ratios of Final Output to Total Production for Main Crops

	Up to 1929	1929-1950s	1960-1964
Wheat	0.860	0.860	0.929
Barley	0.344	0.255	0.255
Oats	0.200	0.200	0.200
Rye	0.774	0.722	0.464
Maize	0.570	0.470[a]	0.155
Rice	0.990	0.990	0.992
Chickpeas	0.870	0.870	0.874
Broad Beans	0.430	0.430	0.347
Beans	0.890	0.890	0.852
Potatoes	0.765	0.765	0.896
Sugar Beet	0.970	0.970	0.970

Note: [a] 0.37 in the 1950s.
Sources: Simpson (1994); Federico (1992); Ministerio de Agricultura (1979b).

Table A.2
Conversion Coefficients Applied to Livestock Numbers to Derive Meat, Wool and Milk Output, 1891-1924

	1865	1891/1924
Meat (dressed carcass)		
(Kilograms per livestock unit[a])		
Cattle	22.226	37.090
Sheep	2.432	3.675
Goat	11.327	3.626
Pigs	43.681	51.550
Horse		6.360
Wool (greasy[ab])	1.660	1.660
Milk (less animal consumption)		
(litres per livestock unit[c])		
Cow	175	363
Sheep	4.196	3.660
Goat	77.07	63.70

Notes. [a] kilograms per unit of total livestock (not just slaughtered livestock). **1865**. The share of livestock slaughtered comes from García Sanz (1994), but for cattle for which the share has ben raised from 6.36%, the figure provided by García Sanz, to 11.36% in order to include slaughtered young animals. Such proportion is obtained as follows, in the 1933 cattle census, adult animals slaughtered represented 15,68% of its total. However, according to Simpson (1994), when young animals are considered, the percentage increases to 28%. A similar correction for 1865 would result in 11.36% of livestock slaughtered [28*6.36/15.68=11.36]. Lack of information led me to accept dressed carcass weights for 1920 from Flores de Lemus (1926), 38.472 kg por livestock unit and 3.753 kg per sheep and goat unit. **1891/1924.** For sheep and pigs, coefficients provided by Simpson (1994) and Comín (1985a) were applied. Simpson (1994) assumes, following the 1929 Census, that 37.5% of sheep and 59.6% of pigs were slaughtered annually. Comín (1985a) provides dressed carcass weight per unit, 9.8 kg per sheep and 86.5 kg per pig. For cattle and goats total dressed carcass weight/livestock number ratios for 1925-1935 were accepted while for horsemeat it was the 1950 ratio, all from Ministerio de Agricultura (1979a). If, alternatively, Simpson (1994) approach, which assumes that 28% and 38.3% of cattle and goats were sacrified each year, were used, and average dressed carcass weight of 137.4 kg and 9.8 kg, respectively, from Comín (1985a) were applied, the resulting conversion coefficients would be slightly higher than those adopted here.

[b] Simpson (1994), Comín (1985a), Carreras (1983), and Prados de la Escosura (1983) accept this figure. Alternatively, Parejo (1989) suggests 2 kg.

[c] litres per unit of total livestock (not per females). **1865**. He aplicado los rendimientos que proporciona Simpson (1994) yields, 700 litres per milking cow-year, being milking 45% of all cows that, in turn, represented 59% of total cattle. I have adjusted this figure (186 litres per cattle unit) downwards with the ratio between milk production deeived by me and by Simpson for 1891/1924 (363/387). In the cases of sheep and goat, female represented 69,5% and 73,4% of the total, respectively, and I have accepted the milking female/total female ratio for 1929/33. **1891-1924.** 1925-1935 average milk/livestock unit ratios were accepted from Ministerio de Agricultura (1979a). Simpson (1994) estimates for 1929/33 are very close. For cows, Simpson assumed that females represented 75% of cattle, from which 45% were milked, yielding 1,146 litres per head per year. For sheep the corresponding figures were 62.7%, 23.4%, and 25.8 litres and for goats, 65.2%, 60%, and 175 litres.

Sources: Carreras (1983); Comín (1985a); Simpson (1994); Ministerio de Agricultura (1979a).

Table A.3
Coverage of the Sample of Products Included in the Annual Index for Each Agricultural Group at Benchmarks (%) (current prices)

	c.1890	**c.1900**	**1909/13**	**1929/3**	**3 1950**	**1960/64**
Cereals[a]	99.05	99.25	99.50	99.38	99.83	99.79
Pulses[b]	94.22	93.80	92.87	90.18	90.91	87.61
Vegetables[c]	-	35.83	41.79	52.23	51.40	43.67
Raw Materials[d]	41.70	70.30	70.60	81.91	84.53	94.90
Fruits & nuts[e]	44.63	48.30	61.20	68.14	69.15	69.34
Wine (must)	100.00	100.00	100.00	100.00	100.00	100.00
Olive oil[f]	98.44	98.42	95.34	98.03	79.88	95.30
Meat[g]	92.87	92.87	92.87	92.89	98.98	94.70
Poultry & eggs	-	-	100.00	100.00	100.00	100.00
Milk & honey[h]	98.30	98.30	98.32	98.30	98.28	98.40
TOTAL	77.48	79.88	86.40	86.13	86.50	85.14

Notes: [a] wheat, barley, rye, oats, maize, rice; [b] chickpeas, broad beans, beans; [c] potatoes, onions.

[d] sugar beet, sugar cane, wool, silk cocoons, cotton (since 1950), tobacco (since 1950);

[e] almonds, oranges, carobs, apples, chestnuts, lemons, bananas (only almonds and oranges before 1910).

[f] olive oil, no olives and sub products included; [g] beef & veal, lamb & mouton, goat, pork, horsemeat (since 1950); [h] milk only.

Sources: See the text.